FLIGHT

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DIARY OF CURRENT AND FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in this list:—

Oct. 27. "Aeroplane Covers and Wheels." Lecture by Mr. F. Fellowes, before R.Ae.S. (Joint Meeting with Inst. of Rubber Industry.)
Oct. 27. Public Luncheon, The Wayfarers' Travel Agency, Ltd., at Criterion Restaurant. Discussion:—"Travel in the Air."
Nov. 1. Junior Ae.C. Dinner to Flt. Lt. C. F. Uwins and Prof. A. Piccard.
Nov. 3. "Civil Primary Training." Lecture by Mr. H. G. Travers, D.S.C., before R.Ae.S.
Nov. 4. Central Flying School Reunion Dinner, May Fair Hotel, W.
Nov. 5. No. 208 Sqdn. R.A.F. Reunion Dinner, Carr's Restaurant, Strand, W.C.
Nov. 10. "Airscrew Design." Lecture by Mr. D. L. Hollis Williams, B.Sc., A.F.R.Ae.S., before R.Ae.S.
Nov. 12. Reading Aero Club Dance.
Nov. 18-Dec. 4. Paris Aero Show.
Nov. 24. "The Evolution of Aircraft Wireless Equipment." Lecture by Sqdn.-Ldr. H. Leedham, O.B.E., R.A.F., before R.Ae.S.
Nov. 25. Norfolk and Norwich Ae.C. Annual Ball.
Nov. 26. Comrades of the R.A.F. Reunion Dinner, Harrods'.
Dec. 1. "The Behaviour of Fluids in Turbulent Motion." Lecture by Mr. A. Fage, A.R.C.Sc., F.R.Ae.S., before R.Ae.S.
Dec. 2. Hampshire Ae.C. Annual Dinner and Dance.
Dec. 8. "Air Survey. Lecture by Lieut. J. S. A. Salt, R.E., before R.Ae.S.
Dec. 14. "Air Power and Disarmament." Lecture by Group Capt. J. T. Babington before R.U.S.I.
Dec. 15. "Airship Development Abroad." Lecture by Sqdn.-Ldr. R. S. Booth, before R.Ae.S.
Dec. 15. "Lessons of the DO.X." Lecture by Dr. C. Dornier, before R.Ae.S.

EDITORIAL COMMENT

JUDGING by the two Blackburn civil aeroplanes which we illustrate and describe this week, the very old question "Monoplane or biplane" seems now quite definitely to have been answered. And the answer must, we think, be "Monoplane *and* biplane." From a performance point of view, there seems little or nothing to choose between the two types, and although the initial rate of climb and the service ceiling of the monoplane are slightly better than the corresponding figures for the biplane, the rest of the performance figures are so nearly identical as to form no grounds upon which a choice can be made. The two machines were designed to carry the same pay load over the same range at approximately the same cruising speed, and according to estimated performance figures they seem to do so as nearly as makes no difference.

Monoplane *and* Biplane

As would probably be expected, the monoplane has a somewhat higher wing weight than the biplane, but as the permissible gross weight is greater by a comparable amount, the disposable load is the same for the two types.

The monoplane wing area is larger than that of the biplane, and thus the wing loading is for all practical purposes the same for the two machines (11·7 lb./sq. ft.). That being so, it would be expected that the monoplane would have a slightly lower landing speed, and the estimated figures show that the designers expect this. The difference is only 3 m.p.h.

The greater rate of climb and the higher service ceiling of the monoplane, with the same wing loading but with a higher power loading, must be presumed to be due to a greater maximum distance between the "horsepower available" and "horsepower required" curves of the monoplane. One would imagine this to be due to slightly greater "cleanness" of the monoplane, but if so the maximum speeds should have shown a greater difference than the 1 m.p.h. which the designers estimate.

Many years ago, in his series of articles in The Aircraft Engineer (Monthly Technical Supplement

to FLIGHT), Mr. J. D. North expressed the opinion that from a drag point of view there was nothing to choose between the cantilever monoplane and the braced biplane wing arrangements. He came to the conclusion that the extra profile drag of a cantilever wing, which must of necessity be of fairly thick section, was probably almost identical with the external strut and wire bracing of the biplane cellule. The results of the two Blackburn machines seem to bear this out.

It will probably be argued that new developments in monoplane wing construction, such as the introduction of the monospar principle, will tip the scales in favour of the monoplane. The answer to that appears to be that other forms of construction now being tried out promise to give improvements in biplane construction comparable with those which the monospar principle confers on monoplane structures, and so we shall be back where we were, except that the structures of both types will have become lighter, and we shall be that much nearer to the time when civil aviation can, to use the Churchillian phrase, "fly by itself."

One then comes to the conclusion that the future will see both the monoplane and the biplane used, and that the choice will, apart from the personal preferences of individual designers, rest upon considerations other than performance, such as controllability, and the ability or otherwise of remaining true without the need for re-rigging during service.

Passengers of aircraft have, like those of ocean liners, their likes and dislikes. Just as the shipping companies have found that, ridiculous as it may seem, the number of funnels affects the booking, so aircraft operating companies are finding that passengers are definitely reassured by a multiplicity of engines. It is quite possible that in future they will find that passengers have preferences in the matter of wing arrangement, and we are quite prepared to find that the non-technical passenger will prefer the cantilever monoplane because its deep thick wing looks so solid, whereas the thin biplane wing, with slender struts and inconspicuous wires, looks flimsy. One may smile at such views, but they may well be found in the future to have a not unimportant bearing on bookings.

For what purpose the two new Blackburn machines are to be used once Martlesham has finished the comparative tests on them we are not informed. The original intention, as announced in one of the Annual Reports on the Progress of Civil Aviation, was to use them in African districts situated at considerable altitudes, such as in Kenya. Whether or not that is still the intention we do not know. Presumably Imperial Airways would have something to say about the operation of experimental machines, and if it should so happen that the two Blackburn types do not fit in with the plans of Imperial Airways, we would suggest that the machines be hired out, at nominal cost, to any firm of standing which would undertake to operate a feeder line linking up with the Cairo-Cape Town route, or with any other British Empire route where a demand exists, but the traffic for which is not such as to justify the operation of a directly subsidised line.

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That A.N.D. 11

Our Editorial Comment in last week's issue on A.N.D. 11, and in particular that section of Air Navigation Directions which deals with experimental flying, has called forth numerous letters from readers, who thank FLIGHT for having called attention to the hampering effect which these over-strict regulations may easily have, should we at any time be unfortunate enough to be saddled with officials less inclined to "Stretch the law a point" than are those in office at present. Unfortunately, lack of space prevented us from publishing the letters in this week's issue, but next week we hope to publish, at any rate, some, or extracts therefrom, of the many which have reached us, as the subject is one which deserves to be thoroughly ventilated.

As at present operated it would seem that A.N.D. 11 places upon the D.C.A. the onus for recommending that an application for permission to fly be granted. Should the D.C.A. happen to be away it would, presumably, fall to the D.D.C.A. to make the recommendation, but he might well excuse himself, not being a technical man, and first want to get the advice of the D. of R., the D.T.D. and the D.A.I. As likely as not, the D. of R. recommends that the recommendation go through. The D.T.D. cannot be expected to say anything about it, because he will not have had drawings, etc., through his department, while the D.A.I. has not inspected the bits and pieces and cannot, therefore, know whether the right materials have been used.

A sort of vicious circle therefore seems to exist: You may not fly a new machine until it has its C. of A., and you cannot get a C. of A. until the machine has flown. Granted that the present officials do their utmost to help, but they are bound by the regulations just as much as is the applicant for permission to fly, and it is unfair that they should be in the invidious position of having to interpret the law liberally if they are not to hinder instead of helping the progress of flying.

Several new low-power machines have seen the light of day recently, and others are planned. That the marketing of some of these at a low price will do much to popularise flying is not to be doubted, and it would be a gracious as well as a wise act on the part of the Air Council to see that as few obstacles as possible are placed in the way, during the initial stages at any rate.

New low-power engines are being designed for these new light planes, and here again it would be a great help if the fees charged for putting the engines through their acceptance tests could be lowered. It will be quite a long time before these low-powered engines are being sold in hundreds, and while production is small the amount which has to be added to the sale price of each engine to cover the cost of type tests is quite considerable. It should be possible to arrange for engines of up to some definite power, such as, for example, 40 b.h.p., to be type-tested at much lower cost than that which is at present incurred. Much the same applies to the cost of stressing the original design, and here again the Air Council would find that a little leniency would be very well received. Many of the firms planning to build light aeroplanes will be in quite a small way of business for a long time to come, and anything which can be done to make their way a little easier will ultimately result in greater flying activity and greater practical air-mindedness, two desiderata which Air Ministers in the past have enunciated, and which one has now come to take for granted.

FLYING DOWN THE WEST AFRICAN COAST

Lecture (abridged) delivered before the Royal Aeronautical Society on Thursday, October 20, 1932, in the Lecture Hall of the Royal Society of Arts, by Flt. Lt. W. G. Pudney

Being an account of a journey down the West Coast of Africa made by Miss Delphine Reynolds in her "Bluebird," piloted by Flt. Lt. Pudney. The lecture is peculiarly apposite in view of the recent announcement that Mrs. Mollison is shortly to attempt to lower her husband's record from England to Capetown, flying over the West Coast Route

THE purpose of this lecture is to set out the flying conditions in West Africa, starting from Tangiers down the Aeropostale route to Dakar and then down the coast and the alternative route from Oran to Goa on to Jebba. By looking at the map I consider the route London, Marseilles, Oran, Goa, Jebba, thus linking up all the British protectorates, is a better route than the East Coast route to Cape Town.

I visited protectorates such as the Gambia, Sierra Leone, and all the white population are very keen on aviation. The shipping line of Elder Dempster has shipyards at all ports, and any operating line would be well advised to keep in close touch with them as they have the monopoly of the west coast trading.

Operating Staff—Precautions

Great care must be exercised against malaria. Glare of the eyes is another thing one must be very careful of. The sun's rays reflected from dead calm water strikes the eyes and one is attacked by terrific headaches and the eyes will not focus on a given point. I make a point of this because on landing one would undoubtedly meet disaster if the water was calm. The sun is the greatest enemy of mankind on the west coast, and three minutes in the sun without a topee is the equivalent to a hit on the head with a 20-lb. hammer.

Before taking off in a seaplane on rivers, first taxi half a mile to disturb the water, and crocodiles and hippopotami will disappear and prevent one running your float down.

Trans-Saharan Air Routes

There are four points on the North African Coast from which safe crossings of the Atlas Mountains can be made. These coastal ports (all of which are both sea and air ports with good accommodation for seaplanes and aeroplanes) are Bougie, Algiers, Oran and Tangiers.

Between Bizerta (Tunis) and Algiers and between Oran and Tangiers, the crossing of the Atlas is dangerous. Owing to the formation of the mountain ranges and the difference in temperature between the atmosphere of the Mediterranean and the desert the winds are treacherous. The mountains contain a large amount of iron ore in places, possibly magnetic, which is liable to affect the compass.

The crossing at Algiers necessitates an altitude of 6,000 ft. or more. At Oran only 4,000 ft. altitude has to be contended with, and as the slope is more gradual on each side, the effects of the differences in atmospheric conditions are not so noticeable.

Tangiers is an international treaty port where fuel is at its lowest price, being duty free. It also offers the shortest sea passage.

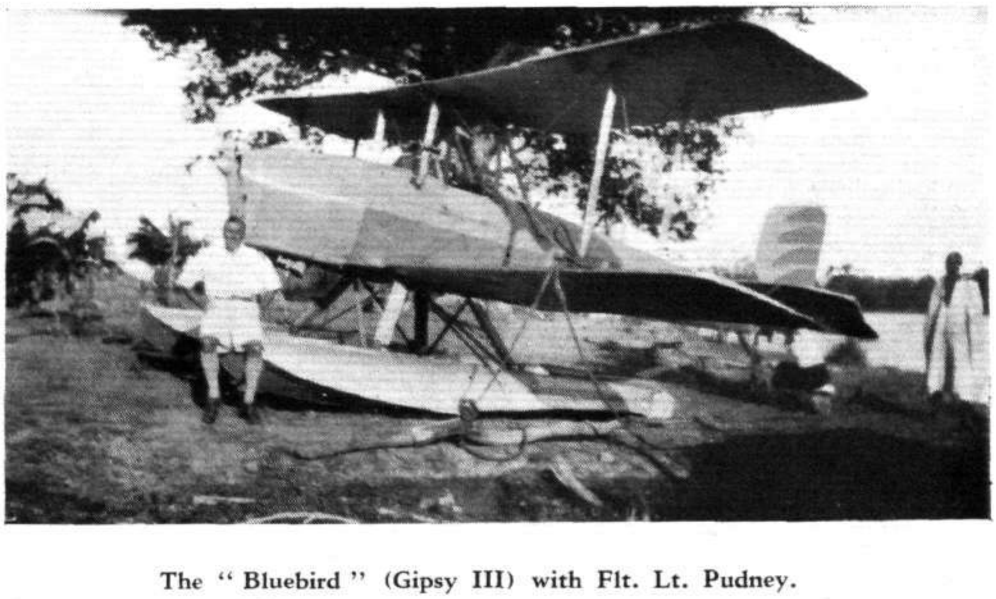
Leaving Tangiers, the best route is to follow the railway south for about 80 miles, then take a course approximately S.E. passing the Fez Railway, then a second railway in a direct line, arriving at Colomb Bechar about 350 miles from Tangiers. Colomb Bechar is a railhead and practically anything necessary can be obtained there. There are also repair shops, wireless station and good hotels.

From Colomb Bechar to Reggan the route is easily traced as the roads can be clearly seen and the whole route follows a line of oases. A number of prepared landing grounds exist, and it is also possible to land almost anywhere with safety. There is no trouble from hostile natives or bandits of any description in this area. Reggan is the final depôt before crossing the Atlas Mountains. It is well supplied with all requirements, a good landing ground, repair shops, fuel and oil supplies, wireless station and a good hotel. The weather is good all the year round, correctly forecast by the meteorological stations and storms are rare. Visibility is good between the Atlas foot hills and the Niger; the air is always clear and free from mist or haze. The prevailing winds are southerly in summer and northerly in winter.

There are two emergency refilling stations on the Tanezrouft, one at Bidon Cinq, on the beaten track at a point about 300 miles from Reggan and another at El Eouit, about 240 miles south of Bidon Cinq. The Tanezrouft is a large area of hard flat level surface with very little drift sand except at isolated places and covered with loose pebbles. The average altitude is about 1,000 ft. above sea level. There is no surface water or wells and no vegetation until reaching the Sudan country, which commences about 90-100 miles south of the emergency refilling station of El Eouit. Sand storms are rare and not very dense at any time, and an aeroplane can easily take an altitude to get above them. The sand storms in the Tanezrouft are not to be compared with those on the Great Ergs where whole caravans can be covered up in the drift sand.

The principal station to make after passing the Tanezrouft is Goa. The Niger forms a horse shoe with Burem at the bend, and on picking up this point the river is followed to the south-east for about 50 miles, where Goa will be easily seen as it is a town of considerable size. There is a good hotel of the Cie General Transsaharaienne at this town and an ample supply of fuel, oil and other supplies. With the exception of the Mangrove and wooded banks of the Niger, the route from Goa to Niamey and on to the Nigerian Frontier or the Northern part of Nigeria is all Sudan country consisting of rolling ground covered with bush. The main roads are good for motor traffic and safe landings can be made in many places. Food is good and plentiful everywhere on the route except on the Tanezrouft.

The route *via* Oran is the most practical, at any rate



The "Bluebird" (Gipsy III) with Flt. Lt. Pudney.

for the present, and Algiers is also a good route *via* Jelfa, Ghardaia, El Golea, Fort McMahon or In Saleh and Reggan. At El Golea there is a good landing ground, W.T. station and a luxurious hotel.

The French are very courteous to private airmen and give them every assistance, but it is necessary to have all arrangements made in advance as the stations are not prepared for sudden demands for supplies.

The Eastern route *via* Tunis and over the Hoggar *via* Fort Flatters and Fort Lapperine and Agades is an extremely difficult and dangerous one. It is also the only part where any hostile natives might possibly be found. The Toureg have been subdued, but some of the natives of Italian Libya are not so docile and may stray into this area.

Towing the "Bluebird" to the slipway where the floats were fitted.

Route Oran-Goa

I would suggest the following route. Follow railway through mountains to Sid-bel-Abbes, then to Bedeau, a compass course to Mecheria, the same line to Figwig and then on to Colomb Bechar, and Tarhit. Igbi Beni Abbes and on to Kerzaz and Adrar, follow the road to Reggan, Bourem and River Niger to Goa. From Goa follow the River Niger to Niaming, the same river to Bussa on the Jebba.

The River Niger can easily be followed from Jebba to where it meets the River Benue and then on to the coast, striking off to Lagos, Port Harcourt, or Calabar, to Daula, Libreville, Cabinda, Benguela, Mossamedes, Walfish Bay, Luderitz—Capetown. I should recommend flying boats from Daula to the Cape.

A very fine aerodrome is now situated at Cape St. Mary (Gambia).

I pointed out that if the aerodrome was maintained a charge could be made, *i.e.*, standard Air Ministry charges. These were given and I am at a loss to think what Mr. Bert Hinkler thought when he made his magnificent flight across the Atlantic, and on arriving at this aerodrome was asked for a landing fee!

Tangiers-Dakar

At Tangiers the British Resident Governor was very kind. We left at daybreak in the morning of March 11, 1931; the British residents all turned out in their cars and presented us with a bunch of English heather. A head tribesman, a true Moor, handed us a letter addressed to any Moorish State, in the event of a forced landing in the Spanish Rio de Ora, to the effect that if care was taken to hand us over intact a suitable ransom would be paid to the tribe responsible for carrying this out. At Casablanca we refuelled and flew to Mogodar. The aerodrome is situated on a sand belt near the coast. Great care must be exercised in landing here, and no hangar accommodation is available, the town is typically Moorish. We then proceeded to Agadir. Agadir is situated on the branch of the Spanish Rio De Ora and here we had the first glimpse of what the desert really looked like. Landing anywhere along this area would undoubtedly result in wrecking the machine as the surface of the sandstone is very uneven all the way to Dakar.

Dakar to Bathurst

Safe landings can be made on the Rivers Salum, Jumbos and Kasamana. Very heavy swell between Cape Verda and Cape St. Mary. No alighting should be attempted on open sea.

The principal rivers in the south part of Dahomey are the Mono, Kuffo and Wemi; these discharge into the coastal lagoons, which afford an alighting place for seaplanes between Grand Popo and Wida on the west, and between Kotonu, Porto Novo and thence to Lagos in Nigeria on the east.

Morocco is a Berber country penetrated partially by Arabs. The natives are grouped in tribes, the origin of which is difficult to determine. A large proportion of the natives speak Arabic, but there are a considerable number of Jews in the ports and these speak Spanish.

The summer heat along the whole coast of Morocco is modified by the coolness of the adjacent sea, which from Tangiers to the southward is several degrees below the temperature of the water on the south coast of Spain at that time. At Mogador the climate is good; sea breezes are always blowing; there is scarcely any rain from April to October, and only now and then in the remaining portion of the year.

From Dakar we started off with great difficulty, as the aerodrome was very soft and the previous rains of the night before made our getaway almost impossible. From Mogadar to Cape Jube, the penal settlement of Spain, we met high winds, reducing our ground speed to below 40 m.p.h. The "Gipsy III" engine was pushed to its utmost. We landed there with the wind approaching 50 m.p.h. The machine was manhandled by members of the Aeropostale and the Spanish garrison. Everyone was astounded to find a lady in the machine. They pointed out that in the event of a forced landing her chances of returning to civilisation were practically nil. My chances were definitely worse as I should have been murdered. The flight from Cape Jube to Villiers Cisemoros was uneventful except that small bands of Moors were sighted at various points of the coast.

The aerodrome at Dakar is situated six kilometres from the town and overgrown by mangos and ant hills in various places. It is small and the long run is into the prevailing wind. Hangar accommodation is good. Small repairs can be effected, especially to engines at the workshops in the Naval dockyard and elsewhere. There is a floating crane to lift 50 tons and there are electric cranes to lift 1½ tons. From here we pushed to our first point in British territory, Bathurst.

The following day arrangements were made so that I could fit the floats, which had been previously sent out by boat. One interesting fact about the floats was that when the crate was opened we were surprised to find a huge black mamba. The crate was dropped by the natives who ran in all directions. The floats were fitted to the machine by myself working in the mornings and late evenings. The machine was launched and a christening ceremony performed by the Governor. From Bathurst we flew to Fatchito, and then to Basse which joins French Senegal. Various messages were given by the residents at Basse and I started off with the A.D.C. to the Governor to our first point of call, the famous island, McCarthy Island. We were greeted by the late Capt. Doke, who was A.D.C. to the Prince of Wales on his visit to the West Coast in H.M.S. *Renown*. The flight from Basse to McCarthy Island was done in 3 hr. 15 min. It takes a river steamer 24 hr., once a week. We alighted on a straight stretch of water outside the Government Wharf—a small jetty. Here came our first mishap. The machine

was moored near the Government Wharf to a buoy that had been placed there for our use. During the night a seed-cutter had run into the machine's tail—this type of water-craft plies between one village and another selling ground nuts. It was discovered that a tail plane, elevator and aileron were needed. With the aid of copper wire I repaired the elevator as best I could. I tested the machine and then took off from McCarthy Island to Fatchito in French Senegal. Here the Gambia narrows into a stream and to land on the water is impossible. A forced landing would mean disaster, no available water being large enough. I returned to my base where the water was more suitable and alighted. I visited places such as Caru, and having made a total survey of the Gambia I returned to Bathurst.

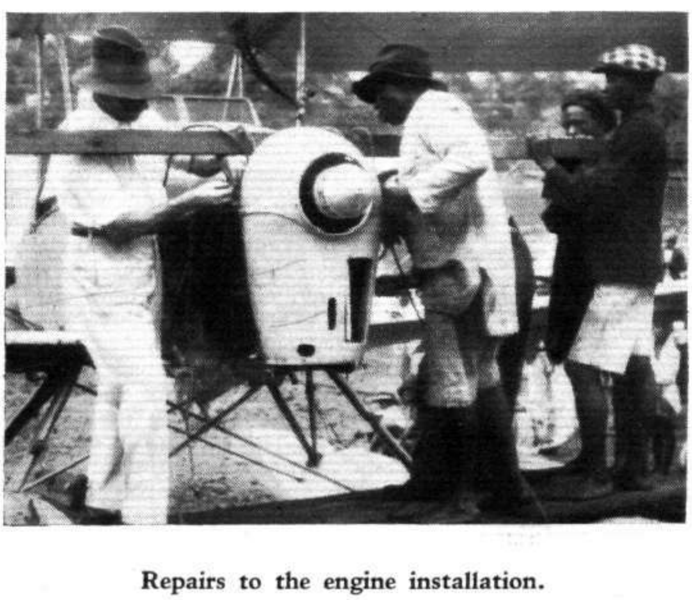
The river Gambia can be navigated quite easily by almost any type of aircraft on floats with a span not over 80 ft. After having returned to Bathurst I fitted the new tail plane and elevator which had arrived from England. Our first British Protectorate in West Africa is very isolated from the outside world in as far as that they depend entirely on mails by boat. The nearest port is Dakar, French Senegal, and I proposed to run a mail service for one day. Instructions were posted from the Post Office at Bathurst. The total mail weighed in the vicinity of 80 lb. The flight was on April 2, 1931, and the flying time from Bathurst was 1 hr. 30 min. The mail was handed over to French officials and a receipt given for them. The letters were taken from the Post Office, on the same day and delivered to Bathurst. The return flying time being 1 hr. 5 min.

Our next point of call was Freetown in Sierra Leone, and we decided to call and make a survey of Boloma, part of Portuguese Guinea, West Africa. The water around Boloma would make an extraordinarily good base for seaplanes. I made a survey of the whole island, and to my utter amazement an aerodrome was being prepared, one kilometre square. From Boloma we flew to Freetown. Here we alighted on the water in very rough weather and eventually the machine was moved in Kingtown Bay. This is very sheltered and the only spot on the whole of that coast line where one could park the machine safely, except up the Lokko Creek, but that would be many miles from Freetown. This I would propose for the alternative base for seaplanes. I was approached by the Governor on the possibilities of an aerodrome at Freetown. I pointed out that it was very necessary, and immediate steps were taken to make an aerodrome. It is about 1,000 yd. square.

One interesting point is a place named Pepal, halfway to Lokko, where the Sierra Leone Development Co. Marranpa ironworks are opening up. Here it was easy to alight on the water.

All the other protectorates in West Africa are wealthy in minerals, and any new air lines would have big development opportunities through the coast in addition to the mails.

A survey was made from Freetown to Blothe in Sherbo island a few miles short of Monrovia, Liberia. With regard to the coast line from Portuguese Guinea to Sherbo, there are many estuaries which could be used for alighting in the case of forced landing or if one met a tornado.



Repairs to the engine installation.

Corrosion

Metal covered with enamel or stove enamel will not resist the acid contained in the water coming from the mango swamps. Corrosion sets up quickly as far as seaplanes are concerned unless treated with cadmium. The floats were of Short manufacture, and all the external fittings were treated with cadmium and no signs of corrosion took place. In the machine itself the external fittings, not so treated, were eaten away in the very short space of time of 2½ months, rendering the machine totally unairworthy. Samples of water were brought back in test tubes and handed over to the Air Ministry, together with specimens of metal that had been placed in the water to study the effects. The sea water itself is not so bad, but the rivers contain certain corrosive matter which affects any metal in a short time.

I recommend materials to be used in aeroplanes or seaplanes operating on the west coast, to be of steel treated with cadmium coating, but I prefer stainless steel. All the fittings of stainless steel in our machine withstood the effects of corrosion. Ample ventilation must be made in the fuselage and all covered fabric parts of the aeroplane, as humidity rises to 95 deg. at times and sets up corrosion. I should recommend a machine of not over 5,000 lb. all up weight and well powered for use in the up rivers to withstand heavy seas.

Seaplanes would not be of any use unless they were of a quick manœuvrable type on the water so as to avoid moving sandbanks and currents, or floating *débris*.

Oil

Oil temperature rises very high, and I recommend that the very best oils be used and the oil filters changed at least every 10 hr. Petrol, especially if centre section tanks are used, must be carefully filtered. A loss of up to 3 galls. in 19 galls. in mid-day will be experienced, through the evaporation if your tank has been filled overnight. Before departing the following morning look at the tank and see what this leakage has been.

Every evening it is wise to cover up the carburettor intake, ventilation pipes and petrol tanks to prevent insects from blocking any pipe lines.

Meteorology

Care must be taken to obtain correct and accurate weather reports from Tangiers before proceeding to Casablanca, and the same applies in leaving Casablanca to Mogador. From Mogador to Agadir one must be careful not to fly after 4 p.m. as sea fog starts at this hour and obscures the aerodrome, and as the Atlas Mountains pass at this point flying out to sea is necessary. One could easily miss the aerodrome at this point and there are not any available forced landing grounds for many miles. At Cape Jube early morning fogs prevail until about 10 a.m. If the wind is blowing from the east the flight should not be attempted, as sand storms are liable to get up, when visibility is approximately only 100 yds. Flying from Cape Jube to Cape Durnford one must have an accurate weather report, if one is to make this landing ground, because of the winds. The same applies from Cape Durnford to Cape Blanco and from there to St. Louis and Dakar. One always has a following wind above 3,000 ft. The wind would be adverse from Dakar to the Gold Coast. The average weather and prevailing winds throughout the year are S.W.W. From 6 a.m. to 10 a.m. wind nil. From 10 a.m. to 2 p.m. wind 25 to 30 m.p.h. From 2 p.m. to 4 p.m. wind drops a little. From 4 p.m. to 6 p.m. the maximum speed of the wind is 15 m.p.h. From 6 p.m. dead calm. In the rainy season, March, April and May, heavy rains are experienced and light rain in September from five to six weeks. Clouds at 500 to 3,000 ft. Tornadoes come from one direction, N.E. to E., at a speed of about 75 m.p.h. Throughout the coastline there is local fog in mornings which clears about 10 a.m. Clouds 2,500 ft., if electrically charged, mean approaching tornado winds. A change of wind from S.W. to W. indicates an approaching tornado. The fog, or sea mist, is never thicker than 500 ft.

In conclusion I would like to mention to all interested in the progress of aviation and the development of new air lines, especially in West Africa, that this flight was made possible by Sir James Reynolds, M.P. for Liverpool Stock Exchange Division, and Miss Delphine Reynolds, and their keenness in aviation. Sir James had previously been down the coast and saw its immense possibilities. I acted as pilot and navigator for the work and took all the observations set out.

BIPLANE OR MONOPLANE ? The two Blackburn machines built to settle this question. (FLIGHT *Photo.*)

Biplane or Monoplane?

EVER since the earliest days of flying, aircraft designers have been divided on the question: monoplane or biplane? The Wright Brothers were "biplanists," but, on the other hand, Langley's "aerodrome" was a tandem monoplane. In France the Voisin and Farman Brothers favoured the biplane, but the monoplane soon made headway, and of French designers Blériot was, perhaps, the first to make the monoplane a real success. In Great Britain early flying history was made chiefly by the biplane, and for a period at any rate the monoplane was under official ban, as a result of certain wing breakages. Yet it should not be forgotten that Robert Blackburn, one of the earliest of independent British designers, devoted his earliest energies to the development of the monoplane, and for several years it was this type which was associated with his name. The question has remained unsettled until the present day, and not until quite recently has an effort been made to solve it by having two machines built, as similar as possible in everything but wing arrangement, so that one may be "flown against" the other. The order for these two machines was placed with the Blackburn company at Brough by the Air Ministry, and the two machines have now been finished and are doing constructor's trials preparatory to being sent to Martlesham for official tests.

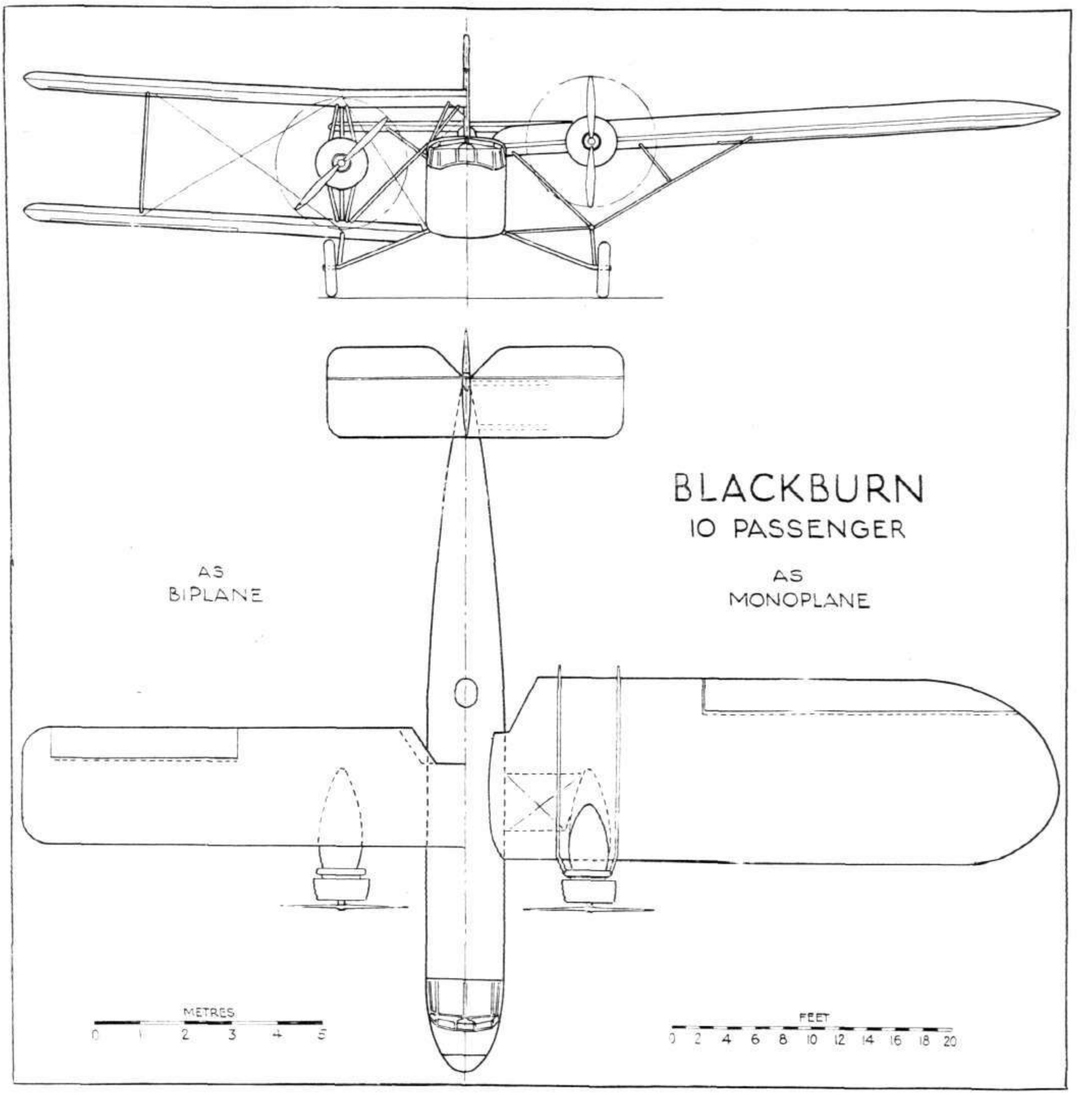
In the design of the two machines, it was decided to incorporate as many common features and units as possible in order that the comparison of the two types might be based upon identical specifications. Thus the two types are designed to carry ten passengers in identical cabins, to have the same cruising range with the same engines, to have the same pay load (2,000 lb.), and to have as nearly as possible the same landing speed. The units common to both types include fuselage, engines, undercarriage, and tail. This has, perhaps, meant compromise in a few instances, such as in the arrangement of the undercarriage of the monoplane, but was considered worth while, not only because of the strict comparison which it made possible, but also because in that way certain economies in manufacture could be obtained.

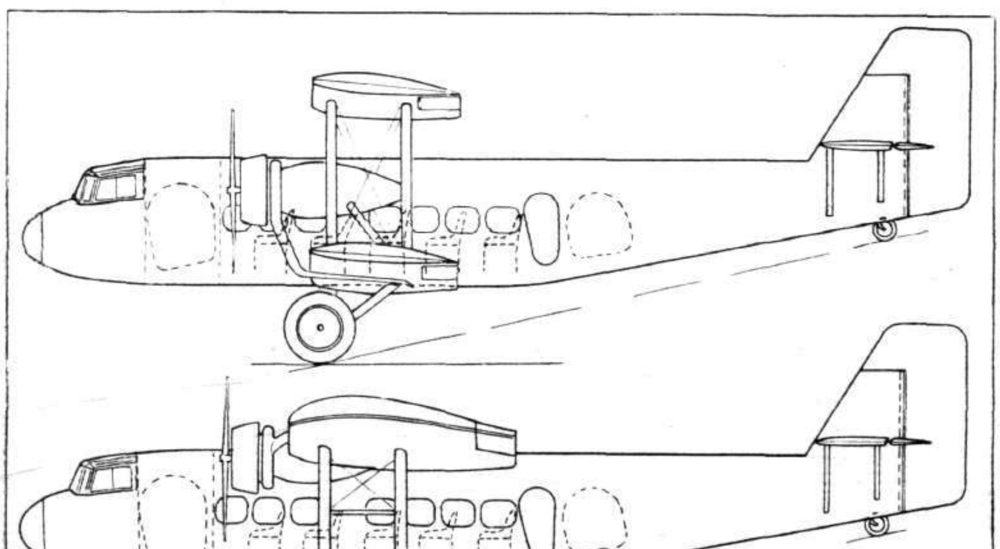
The two Blackburn civil types are of all-metal construction, with the exception of wing and control surface covering, which is doped fabric, it being held by the designers that this is preferable as it is cheap, light, and readily renewable, and gives a maximum of inspection facility.

THE TWO BLACKBURN CIVIL MACHINES : The fuselages, etc., are identical. The engines in both types are Jaguars. (FLIGHT *Photos.*)

The fuselage is of a form of construction not hitherto tried in this country. A corrugated skin of "Alclad" is riveted to closely spaced internal formers, and reinforced by a certain number of longitudinal stringers, although the corrugations of the skin stiffen it considerably and make it the better able to support compression loads without buckling. The skin is applied in fairly large panels, and as the fuselage has rounded corners, the skin corrugations over the rear portion (where the taper occurs) sweep inwards around the corners, finally to meet on the bottom centre line where the joint is well out of sight. Not that the joint is at all unsightly as a joint. In fact, Blackburns have made a very neat job of joining adjacent sheets, by using a standard "three-wave" form of flattening.

The wings of both monoplane and biplane have metal spars and ribs, a type of construction also used in the tail organs. The biplane is a normal two-bay type, with the engines carried on special gap struts approximately midway between top and bottom wings. The monoplane wing is strut braced, and the bracing is so arranged that the points of attachment to the fuselage are the same as





on the biplane, so that placing of bulkheads, wing fittings, strut fittings, etc., is unaltered. The wings are not designed to fold on either machine. Bristol-Frise type ailerons are used on both types.

The undercarriage of both machines is of the "split" type, with oleo-pneumatic compression struts and Dunlop wheels fitted with Bendix brakes. A castoring tail wheel is fitted, and permits the machines to be swung in very small circles by the independently - operated wheel brakes. On the biplane the shock-absorbing leg is attached to the lower wing. On the monoplane a somewhat elaborate structure has been used, so as to enable the same points of attachment to be used by the common undercarriage unit.

The power plant of both machines is the Armstrong-Siddeley "Jaguar" IV C, of 400 h.p. In the monoplane the engines are carried in streamline

THREE-QUARTER REAR VIEWS : The two Blackburn machines at Brough, ready to go to Martlesham for test. (Flight *Photos.*)

nacelles, placed in accordance with latest practice slightly ahead of the leading edge, and on a level with it. This placing has been found to give the least interference drag, and to give the best all-round results. The petrol tanks, of a total capacity of 170 galls. (773 litres), giving a cruising range of 356 miles (572 km.), are placed inside the wing of the monoplane, and in the top plane of the biplane.

The cockpit has accommodation for two pilots side by side, and is exceptionally roomy, as well as affording an excellent view in all important directions. A door in the back wall leads to the luggage compartment and thence to the cabin.

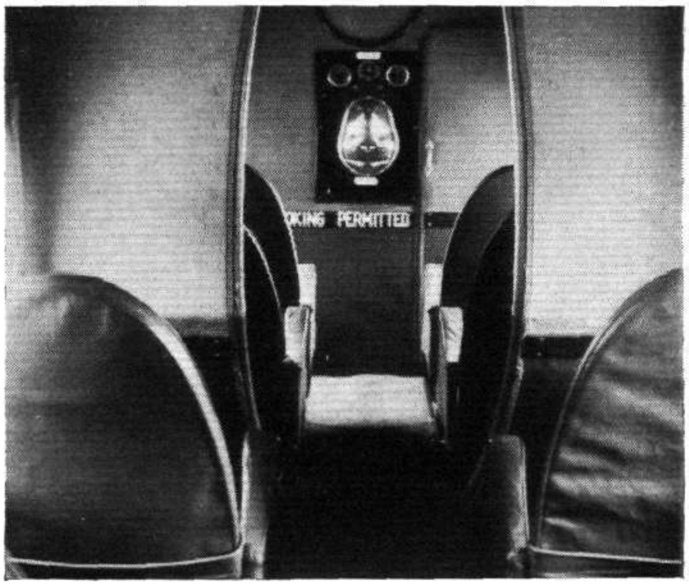
A partition with a door opening in it divides the cabin into two compartments, of which that in front has four seats and the aft compartment six seats. The seats are by no means crowded together and are very comfortable, having good upholstery and adjustable backs. The lower half of the cabin is lined with leather, and the upper with cloth to match the leather, the whole giving a very "cozy" appearance. The space between the cabin lining and the metal wall is filled with Kapok, which assists materially in reducing engine noise. Ventilation has been well attended to, and by each seat there is a spherical louvre, universally mounted, so that the passenger can direct the air as he wishes. Warm air is conveyed from heater muffs on the exhaust pipes.

The capacity of the cabin is **540** cu. ft. (15,3 m.³). The luggage compartment between cockpit and cabin is of **127** cu. ft. (3.5 m.³) capacity, while the smaller luggage and mail compartments aft of the cabin has a capacity of **100** cu. ft. (2,8 m.³).

The main dimensions of the machines are:—Biplane: Length o.a., **54** ft. **8** in. (16,7 m.); wing span, **64** ft. (19,5 m.); height, **15** ft. **7** in. (4,8 m.); wing area, **1,037** sq. ft. (96,4 m.²).

The monoplane has the same overall length as the biplane, but the height is **14** ft. (4,3 m.), the wing span **86** ft. (26,2 m.), and the wing area **1,068** sq. ft. (99,1 m.²).

The following table gives some interesting comparative figures of weight items for the monoplane and biplane:

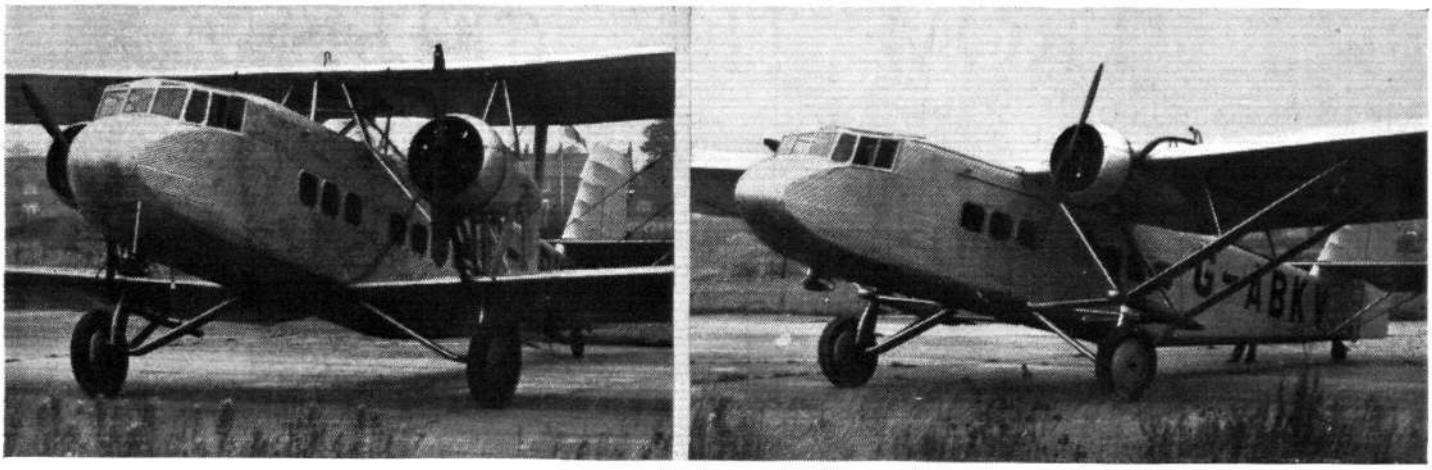


THE CABIN : A partition divides it into two compartments. Note that smoking is permitted. (Flight *Photo.*)

SUMMARY OF WEIGHTS

	Monoplane			Biplane		
Weight of—	lb.	kg.	Per cent.	lb.	kg.	Per cent.
Wing structure ..	2,621	(1,190·0)	20·85	2,154	(977·0)	17·73
Fuselage	2,001	(907·0)	15·92	2,037	(924·0)	16·77
Tail unit	262	(119·0)	2·08	244	(119·0)	2·01
Land chassis ..	557	(252·0)	4·43	557	(252·0)	4·59
Power plant ..	2,314	(1,051·0)	18·32	2,314	(1,051·0)	19·05
Fuel	1,339	(607·0)	10·66	1,392	(632·0)	11·46
Fuel system ..	160	(72·5)	1·27	121	(55·0)	1·00
Load	2,340	(1,061·0)	18·62	2,340	(1,061·0)	19·27
Equipment ..	986	(447·5)	7·85	986	(447·5)	8·12
Weight fully loaded	12,580	(5,707·0)	100·00	12,145	(5,518·5)	100·00

ON THE BANKS OF THE HUMBER : The two Blackburn civil machines from above. (Flight *Photos.*)



THE BLACKBURN MACHINES : The unusual undercarriage of the monoplane is due to the use of the same points of attachment being used as on the biplane. (FLIGHT *Photos.*)

To obtain a clear indication of what these comparative figures mean it is necessary to examine some of the weight items in slightly more detail. As would be expected, the monoplane wing has come out a good deal heavier than the biplane wings. Incidentally, in both cases the figure includes weight of engine mountings and nacelles. As the monoplane wing area is greater, the specific wing weight is not as greatly different as the figures indicate, being **2.45** lb./sq. ft. for the monoplane wing and **2.08** lb./sq. ft. for the biplane wings.

The fact that the fuel weight of the monoplane is smaller than that of the biplane is due to a slightly smaller quantity being carried. There is a slight increase in the petrol system weight of the monoplane, due presumably to the fact that in the biplane the engines are almost directly under the tanks, and the whole system thereby simplified.

As the two machines have not yet been through their tests at Martlesham, actual performance figures are not available, but the estimated performance figures are of interest in showing that from a performance point of view the two machines are very nearly identical. For example, the estimated top speed of the biplane at sea level is 123 m.p.h. (**198** km./h.), and that of the monoplane **124** m.p.h. (**199** km./h.). The estimated landing speed of the biplane is **60** m.p.h. (**96.5** km./h.); that of the monoplane **57** m.p.h. (**92** km./h.). The biplane has an estimated service ceiling of **11,000** ft. (**3,360** m.), while that of the monoplane is **14,600** ft. (**4,460** m.). The initial rate of climb of the biplane is **630** ft./min. (**3,2** m./sec.), and of the monoplane **730** ft./min. (**3,7** m./sec.). Both machines have been designed for a cruising range of about 350 miles (563 km.), and both have a pay load of **2,000** lb. (907 kg.) for that range.

WITH A POBJOY THROUGH EUROPE

CAPT. MAXWELL, Joint Managing Director of Pobjoy Airmotors, Ltd., recently undertook a journey on the Continent during which he had to go a distance of about **2,800** miles. Naturally this was done by air in the Comper "Swift" with the Pobjoy motor. After leaving Hooton Aerodrome, in Cheshire, on September 14, Capt. Maxwell lunched at Heston, where he cleared Customs and subsequently landed in Brussels at 6 p.m.

The following day Rotterdam was reached at dusk, after an interval at Antwerp for several business meetings. At Rotterdam Capt. Maxwell was shown the Pobjoy-engined Pander "Multi Pro" (described in FLIGHT for May 13, 1932), and after an evening with Mr. and Mrs. Koolhoven, Amsterdam was reached the following morning in thick weather. The lunch stop that day was at Hanover, and Berlin was reached later in the afternoon. Warnemünde was reached on the Monday, despite a forced landing in a field necessitated by a terrific thunderstorm.

Returning to Berlin by dusk, Capt. Maxwell spent the evening with Mr. Sedlmayr, of "Autoflug," and the following morning he left for Kassel. Here he met Herr Fieseler and saw the tailless twin Pobjoy-engined machine which is said to have a top speed of **146** m.p.h. After a somewhat hectic journey in bad weather, Nürenberg was reached the following night. The journey continued to Augsburg the following morning. The next stop was Böblingen, where the aircraft works of Dr. Klemm were visited, and later in the day Strasburg was reached. The trip to Paris the following morning was not without incident. The wind was so terrific over the Voges that a landing was perforce made at Nancy for the night. Ironically enough the trip to Le Bourget was made the following morning in perfect weather.

Over **41** hr., including a large amount of demonstration work, were flown during the trip, and the cost of petrol and oil only came to £22 17s. Throughout this time a cruising speed of approximately **115** m.p.h. was maintained and no adjustments at all were found to be necessary to the machine or the engine. A journey like this is a distinct contrast to the same route when that is travelled by train. Over **250** miles were covered each day, but the time taken in travelling was only $2\frac{1}{2}$ hr., thus leaving the whole of the rest of the day free for business, combined with the comfort of spending each night in a hotel instead of a train.

Monospar Cabin Very Quiet

WE recently took the opportunity of trying the Monospar which has now been fitted with four-bladed airscrews. The improvement is most noticeable. The cabin is now the quietest of any light cabin machine we have tried, and conversation can be carried on without raising the voice—an important factor in reducing fatigue on a long journey. The new airscrews give this interesting aircraft a cruising speed, at normal r.p.m., of **114** m.p.h., and there is no doubt of the ability to maintain height with full load when one engine is shut off. With regard to this desirable characteristic the Martlesham figures show that height was maintained on full load at **6,000** ft. Manœuvring under these conditions is perfectly simple and turns can be made against the engine with ease. It is also remarkable how well the Monospar flies "hand and feet off"; this naturally means that the machine is admirable on long journeys. As a further variation it is amusing to fly in this manner and to make turns simply by the use of the two Pobjoy engines. The interest aroused by the machine in both Italy and Switzerland has been very great and will, we imagine, be even greater in the near future.

Werner Stocklin, Rue de Montchoisy 2, Geneva, Switzerland, is the address of the Swiss agent for General Aircraft, Ltd. A demonstration model will be delivered to him early in November. A particularly beautiful looking model finished in aluminium with red panels, by Cellon, Ltd., has just been delivered to Heston as a demonstration model for Brian Lewis & Co., Ltd., who operate from that airport.

FROM THE CLUBS

MAIDSTONE AERO CLUB

On Friday, October 21, the club held their autumn dance to which quite a large number of people from London came. The success of this one has decided those responsible to hold a series throughout the season. On Sunday, November 6, the club will be holding their monthly At Home when members are particularly asked to come and meet the new manager, Mr. M. Spencer. Interesting results have come to hand of the balloon race which was held on Sunday, October 16. One which went up at **3.30** p.m. was found at **6.45** a.m. on Monday at Lausanne, a distance of **450** miles. It has been calculated that this balloon must have averaged 35 m.p.h. Numerous others have been sent back from the Somme and Marne, but up to the present the one from Lausanne is the winner.

N.F.S.

Despite the rain and strong wind at Yeadon, over 20 hr. flying has been put in during the past week.

Eight machines left Hanworth on October 16 for a trip to Blackpool to attend the illumination festivities. Many other members have carried out cross-country flights and the night-flying arrangements were very well patronised on Wednesday until quite late.

LONDON AEROPLANE CLUB

The bad weather during the last few weeks having seriously curtailed flying, advantage has been taken during this time of improving the comfort of the clubhouse, while the heating system has been overhauled. Mr. M. P. Spencer, who, as our readers know, has ably carried out the duties of Assistant Secretary for the past four years, is leaving at the end of the month to join the staff of Maidstone Airport, Ltd. A farewell party is being held in conjunction with the house dance on November 5. It is hoped that all his friends will be there to say goodbye.

BROOKLANDS

An interesting display will be staged on November 5 when a meeting is especially being arranged for children. This will naturally coincide with the many bangs and pops usually connected with Guy Fawkes' Day. Over a thousand children are expected.

BENGAL FLYING CLUB

The club was closed down for six weeks from August 4 for the annual holiday. A change of instructors has now been made, Mr. W. Dougall taking the place of Mr. Warner, who has been the club instructor for the past three years. Excellent weather favoured the resumption of flying on September 17, although parts of the aerodrome remained somewhat wet. No licences were granted during September, but quite a large number of members are hoping to qualify during October. Besides Dr. A. M. Leake, Mr. A. H. Y. Ali has now also purchased a Comper "Swift" and intends to fly to Assam in the near future. Mr. K. Pradhan has been appointed aerodrome officer. Many of the members have made cross-country flights to such places as Dacca and Maheshganj. During August and September the club office was transferred from Outram Institute to the new club buildings on the aerodrome. The total number of members is now 332, of which 82 Europeans and **50** Indians are flying members. 64 hr. were flown in September, 24 hr. 30 min. being instructional.

READING

The exceptionally bad weather of the past week naturally accounted for the small amount of flying put in. Amongst those who, however, used their machines extensively were Messrs. Courtney, Longden and Alchurch, who are taking their "Spartan" (Hermes II) to Nairobi shortly for a big game hunting trip. Their itinerary for the flight out allows for a ten-day trip. With regard to the dance which, as reported in last week's notes, is taking place on Saturday, November 12, the price of the tickets should have been 3s. 6d. single and 6s. 6d. double; the dance begins at 8.45 p.m.

LONDON GLIDING CLUB

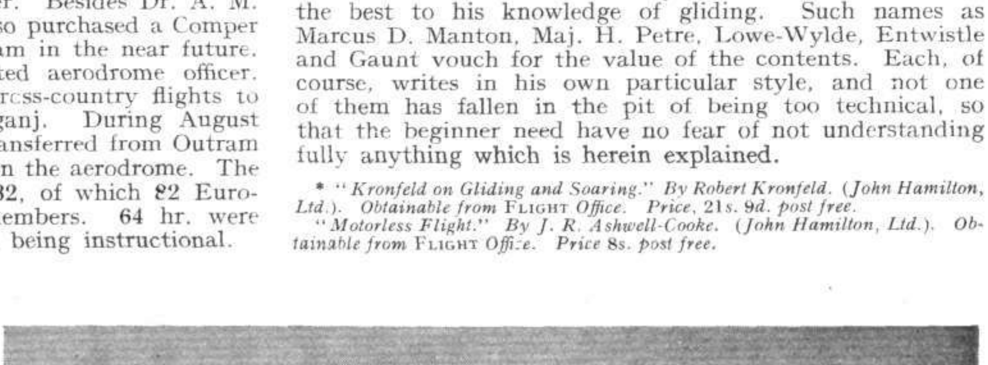
Conditions were quite good for gliding during the afternoons of October 15 and 16, and over 20 pilots made good use of seven machines. The "Scud" and "Crested Wren" were able to maintain heights of between 600 and 800 ft. above the hill top. The total flying time in the day and half approached 20 hr. Elementary instruction for beginners was carried out at the foot of the hill, both by the London Gliding Club and the Imperial College Club, who have just recommenced using the ground regularly.

TWO BOOKS ON GLIDING*

There have recently been published two books, both of which are of very great interest to those who glide. The first of these, entitled "Kronfeld on Gliding and Soaring," is, as its name implies, by that well-known Austrian expert Robert Kronfeld, who has done so much to popularise the movement in this country. It is not a technical book in the true sense of the word and for the most part is written in a popular style which everyone can understand. Its greatest appeal lies, perhaps, in its illustrations, which are profuse and serve admirably to amplify the text in such a manner as to leave no doubt at all what the author is driving at. The introductory part which is historical, is perhaps a little too fully treated, and the manner in which the ancient history of gliding has been gone into typifies the author's national thoroughness. English development is not forgotten, nor is that of the United States, but, of course, the developments in both these countries are treated as of secondary importance when compared to that of Germany. The series of accounts by the author of some of his famous flights are peculiarly interesting, and there is no doubt that there is a very great deal to be learned from a perusal of these. The chapters on elementary schooling, advanced flights, cloud and thunderstorm soaring are very fully and, as already mentioned, excellently illustrated with practical diagrams. One feels that they are, perhaps, a little too German, and that the methods described are somewhat more applicable to the youth of Germany than to the type of member which is now joining our own gliding clubs. Be that as it may, however, there is no doubt that everyone who aspires to becoming an expert soaring pilot will gain a very great deal from reading this book. Chapters on auto and aeroplane towing are full of "meat," and there is much to be learned from the author's failures and successes.

The second book, "Motorless Flight," is a compilation by Mr. J. R. Ashwell Cooke, which includes chapters on all the various practical aspects of gliding by experts in each particular department. Few more practical books have been published and it is undoubtedly one which should be in the hands of everyone who wishes to add of the best to his knowledge of gliding. Such names as Marcus D. Manton, Maj. H. Petre, Lowe-Wylde, Entwistle and Gaunt vouch for the value of the contents. Each, of course, writes in his own particular style, and not one of them has fallen in the pit of being too technical, so that the beginner need have no fear of not understanding fully anything which is herein explained.

* *"Kronfeld on Gliding and Soaring." By Robert Kronfeld. (John Hamilton, Ltd.). Obtainable from* Flight *Office. Price, 21s. 9d. post free.*
"Motorless Flight." By J. R. Ashwell-Cooke. (John Hamilton, Ltd.). Obtainable from Flight *Office. Price 8s. post free.*



The Granger "Archæopteryx" flying at Nottingham. (*Vide* Flight, 31.10.1930.)

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FLIGHT ENGINEERING SECTION

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CONTENTS

A METHOD FOR STRESSING MONOSPAR PYRAMID BRACING

By S. C. Redshaw, M.Sc., A.F.R.Ae.S.

Mr. Redshaw was assistant to Mr. H. J. Pollard, at the Bristol Aeroplane Co., Ltd., for about four years, where he obtained experience of, among other things, multi-spar wings. He relinquished his position at Filton to take up the post of assistant designer at the Croydon works of General Aircraft, Ltd., where he became intimately familiar with the stressing of monospar wings. Mr. Redshaw left Croydon recently to take up structural research work at Cardiff University. In the following article he outlines the method of stressing the pyramid bracing of a monospar wing. The question of initial tension in the wires has not been dealt with, as it is not taken into account for stressing purposes by the R.A.E., but it may be remembered that in his paper before the Royal Aeronautical Society Mr. Stieger referred to the effect of giving an initial tension to the pyramid bracing wires.

Introduction

The success of the Monospar system of pyramid bracing has focussed attention on the stressing methods to be used. At first sight one would be led to suppose that the problem would present some difficulty, but on the contrary very little trouble is experienced, with the possible exception of a pyramid which is entirely unsymmetrical.

The structure is not redundant but pseudo-redundant, because, under any condition of loading, there is one wire which does not receive any load. It is not usual, according to Airworthiness Regulations, to take any account of the initial tensions in the wires; in consequence, for stressing purposes all the wires are assumed to be just tight.

The stressing of both a symmetrical and unsymmetrical pyramid will be considered.

Tension Coefficients

Throughout this work the method of "Tension Coefficients" due to Professor R. V. Southwell* will be used. As the method is not generally known a very brief description of it is included here.

A convenient set of three mutually perpendicular axes are chosen, care being taken to adhere to the convention of signs.

Let the tension in any member AB, say, be T, AB. If the length of AB be l, AB then:—

$$\mathrm{T, AB} = l, \mathrm{AB}.\ t, \mathrm{AB}$$

where t, AB is defined as the tension coefficient of the member AB.

Now the component of the tension in AB along the x axis, for example, will be:—

$$\begin{aligned} &\mathrm{T, AB} \times \frac{x, \mathrm{AB}}{l, \mathrm{AB}} \\ &= l, \mathrm{AB} \times \frac{x\,\mathrm{AB}}{l\,\mathrm{AB}} \\ &= t, \mathrm{AB}\ \ x, \mathrm{AB}. \end{aligned}$$

It should be noticed that t, AB x, AB is the component of T, AB referred to the joint A, while t, AB x, BA is the component of T, AB referred to the joint B and will be of opposite sign. Every member is assumed to be in tension and the three equations of equilibrium for the joint A can be written thus:—

$$\begin{aligned} &t, \mathrm{AB}\ x, \mathrm{AB} + t, \mathrm{AC}\ x, \mathrm{AC}, \text{ etc. } \ldots \quad \ldots + \mathrm{X} = 0 \\ &t, \mathrm{AB}\ y, \mathrm{AB} + t, \mathrm{AC}\ y, \mathrm{AC}, \text{ etc. } \ldots \quad \ldots + \mathrm{Y} = 0 \\ &t, \mathrm{AB}\ z, \mathrm{AB} + t, \mathrm{AC}\ z, \mathrm{AC}, \text{ etc. } \ldots \quad \ldots + \mathrm{Z} = 0 \end{aligned}$$

X, Y, and Z being the external loads applied at the joint A. Three such equations can be written down for each joint of the frame. The solution of the complete set of equations gives the values of the tension coefficients. Each coefficient multiplied by the length of its respective member yields the load in the member. A negative sign shows the member to be in compression.

The Symmetrical Pyramid

A completely symmetrical pyramid may be defined as one in which the corresponding co-ordinates of all the wires are identical. Fig. 1 shows a typical pyramid.

For the purposes of stressing, each pyramid can, of

* Primary Stress Determination in Space Frames. R. V. Southwell, *Engineering*, Feb. 6, 1920.

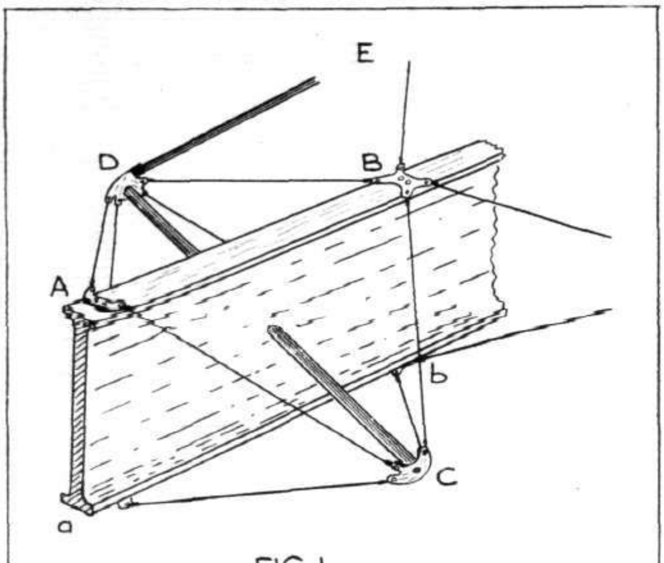


FIG. 1

course, be considered as a separate unit. The object of the wire bracing is to take the torsion and drag loads, lift loads being taken by the spar in the normal manner.

In the case of wing bracing it is usual to use the leading edge as the member DE, but if a wire is used it is necessary to have a wire on the opposite side to cater for the anti-drag. It is convenient to stress the structure under torsion and drag loads separately. Fig. 2 and Table I give the dimensions of a typical symmetrical pyramid.

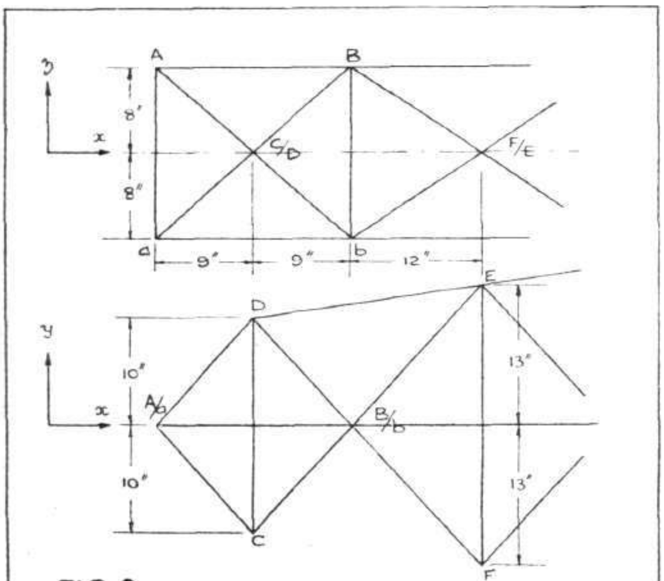


FIG. 2

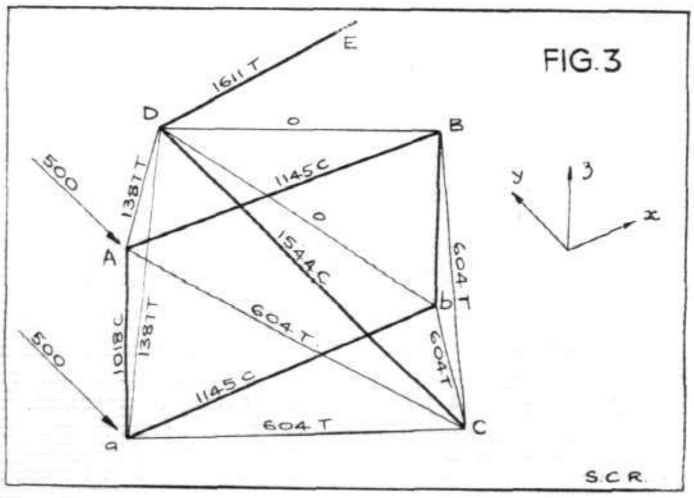


FIG. 3

TABLE I

Member	x	y	z	Length
AB ...	+ 18	0	0	18·0
ab ...	+ 18	0	0	18·0
Aa ...	0	0	− 16	16·0
Bb ...	0	0	− 16	16·0
CD ...	0	+ 20	0	20·0
AC ...	+ 9	− 10	− 8	15·65
AD ...	+ 9	+ 10	− 8	15·65
aC ...	+ 9	− 10	+ 8	15·65
aD ...	+ 9	+ 10	+ 8	15·65
BC ...	− 9	− 10	− 8	15·65
BD ...	− 9	+ 10	− 8	15·65
bC ...	− 9	− 10	+ 8	15·65
bD ...	− 9	+ 10	+ 8	15·65
DE ...	+ 21	+ 3	0	21·21

(*a*) *Drag.*—Drag loads of 500 lb. each are applied at joints A and a, as shown in Fig. 3. The equations of equilibrium for each joint are then set down in the manner described above; the values of the tension coefficients found by their solution are also given.

Joint A

$$\begin{aligned}
x/ &\; + 18\,t\mathrm{AB} + 9\,t\mathrm{AD} + 9\,t\mathrm{AC} &&= 0\\
y/ &\; + 10\,t\mathrm{AD} - 10\,t\mathrm{AC} - 500 &&= 0\\
z/ &\; - 8\,t\mathrm{AD} - 8\,t\mathrm{AC} - 16\,t\mathrm{A}a &&= 0
\end{aligned}$$

$t\mathrm{AB} = -63{\cdot}61 \quad t\mathrm{AC} = +38{\cdot}61 \quad t\mathrm{A}a = -63{\cdot}63$

Joint a

$$\begin{aligned}
x/ &\; + 18\,tab + 9\,ta\mathrm{D} + 9\,ta\mathrm{C} &&= 0\\
y/ &\; + 10\,ta\mathrm{D} - 10\,ta\mathrm{C} - 500 &&= 0\\
z/ &\; + 8\,ta\mathrm{D} + 8\,ta\mathrm{C} + 16\,ta\mathrm{A} &&= 0
\end{aligned}$$

$tab = -63{\cdot}61 \quad ta\mathrm{D} = +88{\cdot}61 \quad ta\mathrm{C} = +38{\cdot}61$

Joint C

$$\begin{aligned}
x/ &\; + 9\,t\mathrm{CB} + 9\,t\mathrm{C}b - 9\,t\mathrm{CA} - 9\,t\mathrm{C}a &&= 0\\
y/ &\; + 10\,t\mathrm{CB} + 10\,t\mathrm{C}b + 10\,t\mathrm{CA} + 10\,t\mathrm{C}a + 20t\mathrm{CD} &&= 0\\
z/ &\; + 8\,t\mathrm{CB} - 8\,t\mathrm{C}b + 8\,t\mathrm{CA} - 8\,t\mathrm{C}a &&= 0
\end{aligned}$$

$t\mathrm{CB} = +38{\cdot}61 \quad t\mathrm{C}b = +38{\cdot}61 \quad t\mathrm{CD} = -77{\cdot}20$

Joint D

$$\begin{aligned}
x/ &\; + 9\,t\mathrm{DB} + 9t\mathrm{D}b - 9\,t\mathrm{DA} - 9t\mathrm{D}a + 21t\mathrm{DE} &&= 0\\
y/ &\; - 10\,t\mathrm{DB} - 10t\mathrm{D}b - 10\,t\mathrm{DA} - 10t\mathrm{D}a + 3t\mathrm{DE} - 20t\mathrm{DC} &&= 0\\
z/ &\; + 8\,t\mathrm{DB} - 8t\mathrm{D}b + 8\,t\mathrm{DA} - 8t\mathrm{D}a &&= 0
\end{aligned}$$

$t\mathrm{DA} = +88{\cdot}61 \quad t\mathrm{DB} = 0 \quad t\mathrm{D}b = 0$

For this case the members DB and Db are inoperative. At each joint there are, however, at least four unknowns, despite the fact that $t\mathrm{DB} = 0$ and $t\mathrm{D}b = 0$. If, by the "method of sections," moments are taken about the z axis through Bb, the value of tDE can be found immediately, thus :—

$$(21t\mathrm{DE} \times 10) + (3t\mathrm{DE} \times 9) = (1{,}000 \times 18)$$
$$237\,t\mathrm{DE} = 18{,}000$$
$$t\mathrm{DE} = +75{\cdot}95$$

We then have three equations at joint D with the unknowns tDA, tDC and tDa, which can therefore be found at once. The substitution of their values in the equations of joints A and a enable these joints to be solved in a similar way and thence to joint C.

It will be observed that there is no necessity for the member DC to be held to the spar. The loads in the members are shown on the diagram.

(*b*) *Torsion.* Loads of 1,000 lb. each but of opposite sense are applied at joints A and a as shown in Fig. 4.

For this case the members AC, aD, DB, Cb and DE are inoperative, the solution of all the equations follows immediately without the slightest difficulty. By adding the loads shown in Figs. 3 and 4 we obtain the net

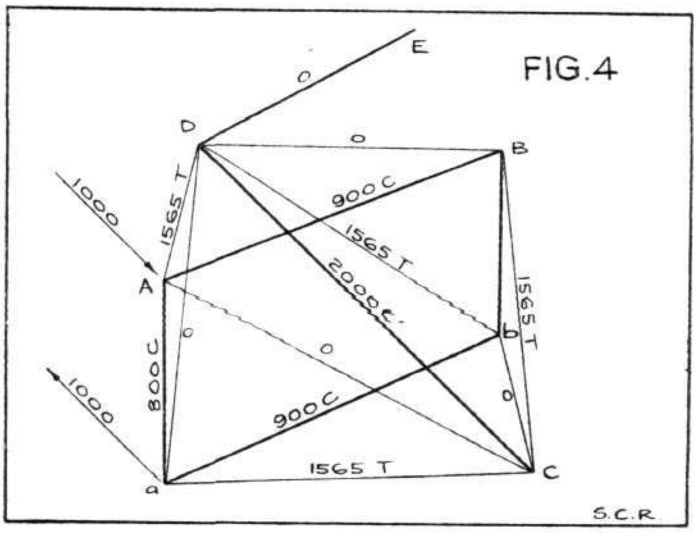


FIG. 4

loads in the structure when it is subjected to both drag and torsion. These loads are given in Fig. 5.

It will be observed that only one member, *i.e.*, DB, is not in operation; had the sign of the torsion been reversed the member D*b* would have been inoperative instead.

The Unsymmetrical Pyramid

An unsymmetrical pyramid may be defined as one in which the corresponding co-ordinates of all the wires are not identical. For example, the spar which is usually tapered, may be tilted at some angle. The dimensions of an unsymmetrical pyramid are given in Fig. 6 and Table II.

TABLE II

Member	x	y	z	Length
AB ...	+ 15	+ 0·352	+ 2	15·14
ab ...	+ 20	− 0·529	− 3	20·23
A*a* ...	− 3	− 2·821	− 16	16·52
B*b* ...	+ 2	− 3·702	− 21	21·42
CD ...	0	+ 20·0	0	20·0
AC ...	+ 5	− 11·587	− 9	15·50
AD ...	+ 5	+ 8·413	− 9	13·30
*a*C ...	+ 8	− 8·766	+ 7	13·78
*a*D ...	+ 8	+ 11·234	+ 7	15·47
BC ...	− 10	− 11·939	− 11	19·07
BD ...	− 10	+ 8·061	− 11	16·91
*b*C ...	− 12	− 8·237	+ 10	17·65
*b*D ...	− 12	+ 11·763	+ 10	19·56
DE ...	+ 21	+ 3·0	+ 3	21·42

In this case the spar has been tapered and tilted, while the joints A and B are not vertically above joints *a* and *b* respectively. It must be emphasised that a pyramid with so many eccentricities is rarely met with, but it provides a good general example.

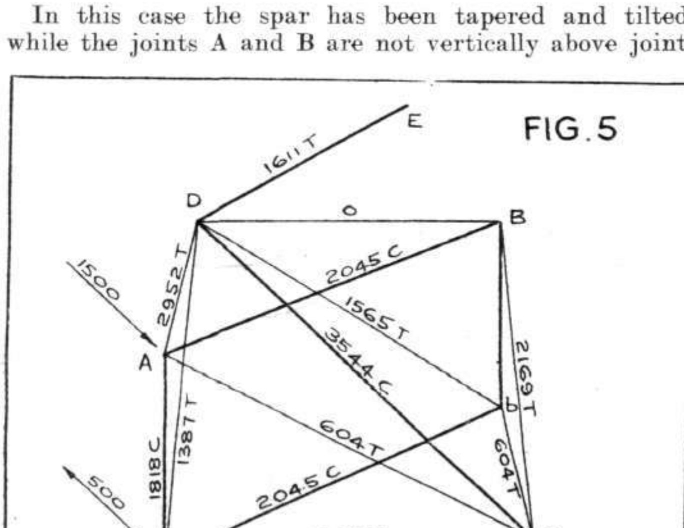


FIG. 5

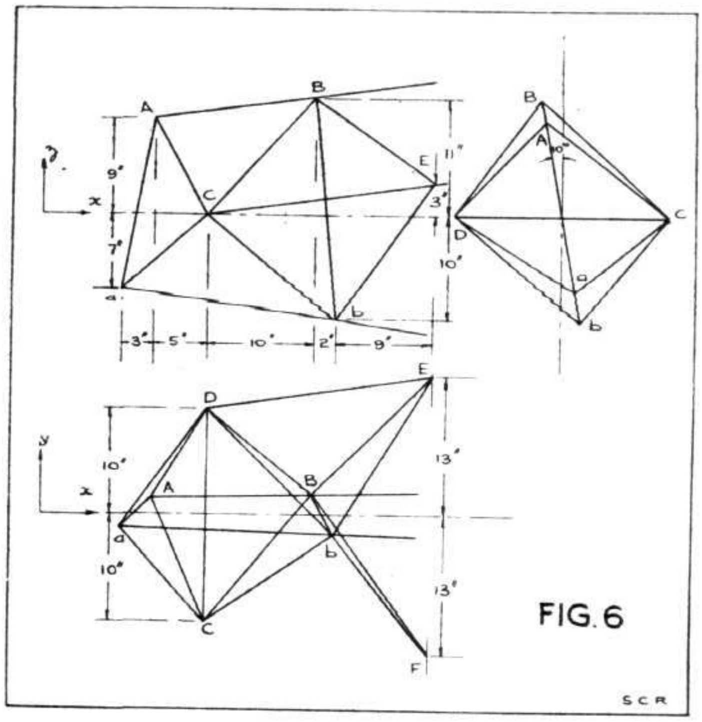


FIG. 6

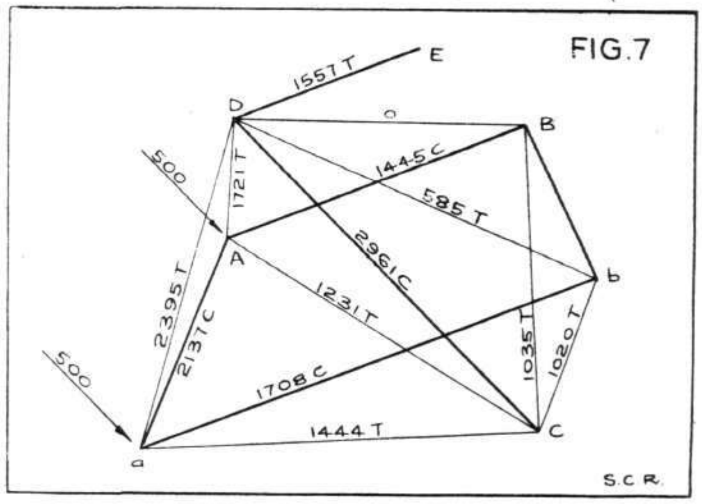


FIG. 7

(*a*) *Drag.* Drag loads are applied as in the case of the symmetrical pyramid, see Fig. 7.

The equations of equilibrium are set down below.

Joint A

$$x/ + 15t\mathrm{AB} + 5t\mathrm{AD} + 5t\mathrm{AC} - 3t\mathrm{A}a = 0$$
$$y/ + 0{\cdot}352t\mathrm{AB} + 8{\cdot}413t\mathrm{AD} - 11{\cdot}587t\mathrm{AC} - 2{\cdot}821t\mathrm{A}a - 500 = 0$$
$$z/ + 2t\mathrm{AB} - 9t\mathrm{AD} - 9t\mathrm{AC} - 16t\mathrm{A}a = 0$$
$$\underline{t\mathrm{AB} = -95{\cdot}47} \quad \underline{t\mathrm{AD} = +129{\cdot}40} \quad \underline{t\mathrm{AC} = +79{\cdot}38}$$

Joint a

$$x/ + 20tab + 8ta\mathrm{D} + 8ta\mathrm{C} + 3ta\mathrm{A} = 0$$
$$y/ - 0{\cdot}529tab + 11{\cdot}234ta\mathrm{D} - 8{\cdot}766ta\mathrm{C} + 2{\cdot}821ta\mathrm{A} - 500 = 0$$
$$z/ - 3tab + 7ta\mathrm{D} + 7ta\mathrm{C} + 16t\mathrm{A}a = 0$$
$$\underline{tab = -84{\cdot}42} \quad \underline{ta\mathrm{A} = -129{\cdot}35} \quad \underline{ta\mathrm{D} = +154{\cdot}80}$$

Joint C

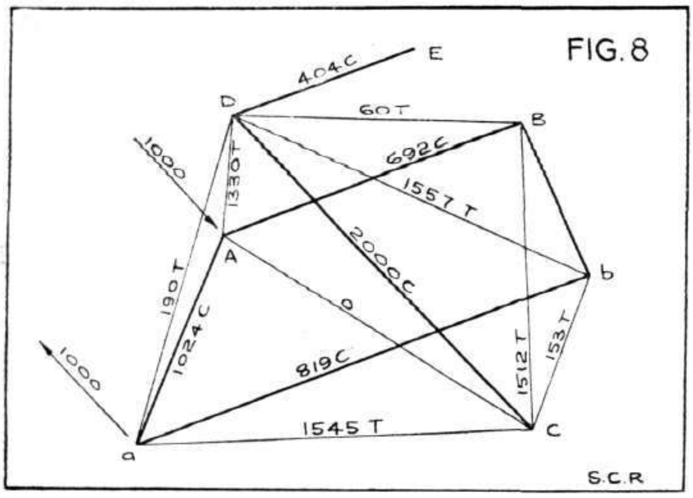
$$x/ - 5t\mathrm{CA} - 8t\mathrm{C}a + 10t\mathrm{CB} + 12{\cdot}\mathrm{C}b = 0$$
$$y/ + 11{\cdot}587t\mathrm{CA} + 8{\cdot}766t\mathrm{C}a + 11{\cdot}939t\mathrm{CB} + 8{\cdot}237t\mathrm{C}b + 20t\mathrm{CD} = 0$$
$$z/ + 9t\mathrm{CA} - 7t\mathrm{C}a + 11t\mathrm{CB} - 10t\mathrm{C}b = 0$$
$$\underline{t\mathrm{CB} = +54{\cdot}25} \quad \underline{t\mathrm{C}b = +57{\cdot}76} \quad \underline{t\mathrm{C}a = +104{\cdot}80}$$

Joint D

$$x/ - 5t\mathrm{DA} - 8t\mathrm{D}a + 10t\mathrm{DB} + 12t\mathrm{D}b + 21t\mathrm{DE} = 0$$
$$y/ - 8{\cdot}413t\mathrm{DA} - 11{\cdot}234t\mathrm{D}a - 8{\cdot}061t\mathrm{DB} - 11{\cdot}763t\mathrm{D}b - 20t\mathrm{DC} + 3t\mathrm{DE} = 0$$
$$z/ + 9t\mathrm{DA} - 7t\mathrm{D}a + 11t\mathrm{DB} - 10t\mathrm{D}b + 3t\mathrm{DE} = 0$$
$$\underline{t\mathrm{DB} = 0} \quad \underline{t\mathrm{D}b = +29{\cdot}88} \quad \underline{t\mathrm{DC} = -148{\cdot}05}$$

Owing to the complete lack of symmetry only one member will be inoperative, *i.e.*, DB. (In certain cases of lack of symmetry both DB and D*b* may be inoperative, but in the general case only DB will be idle.)

From the four joints we have twelve equations with twelve unknowns, these can be reduced to eight equations with eight unknowns in the following way. The



load in the member DE may be found as in the case of the symmetrical pyramid. As the joint B does not lie vertically above the joint *b* it is necessary to transfer the applied loads and certain dimensions into a new set of axes which we may denote by X, Y, and Z, such that the co-ordinates of the member B*b* in these axes are (0, 0, 21.42), 21.42, of course, being the true length of the member B*b*. The spar is tilted at 10 deg. to the *x-z* plane and B*b* makes an angle of 5 deg.-21′ to the vertical in the plane of the spar.

We then have :—

$$X = x\cos 5^\circ - 21' + y\sin 10^\circ \sin 5^\circ - 21' + z\cos 10^\circ \sin 5^\circ - 21'$$
$$Y = \qquad y\cos 10^\circ \qquad - z\sin 10^\circ$$
$$Z = -x\sin 5^\circ - 21' - y\sin 10^\circ \cos 5^\circ - 21' + z\cos 10^\circ \cos 5^\circ - 21'$$

Then by using these transference equations the following loads and dimensions can be translated from the axes *x*, *y*, *z* into the axes X, Y, Z.

Quantity	x	y	z	X	Y	Z
*t*DE	21*t*DE	3*t*DE	3*t*DE	21·234*t*DE	2·433*t*DE	1·502*t*DE
500	0	− 500	0	− 81	− 493	—
DB	10	−8·061	11	10·835	− 9·848	—
AB	15	0·352	2	15·12	0	—
ba	− 20	0·529	3	−19·63	0	—

Moments about the Z axis through B*b* gives :—

$$(21{\cdot}234t\text{DE} \times 9{\cdot}848) + (2{\cdot}433t\text{DE} \times 10{\cdot}835)$$
$$= 493\ (15{\cdot}12 + 19{\cdot}63)$$
$$\underline{t\text{DE} = +\ 72{\cdot}68}$$

Having substituted the value of *t*DE thus found into the equations of joint D, we have simplified the conditions, taking the six equations from joints A and *a* together with the *x* and *z* equations of joint D, we have eight equations and eight unknowns. As *t*DC occurs in only one equation at joint D, it can be omitted together with the three equations of joint C for the present.

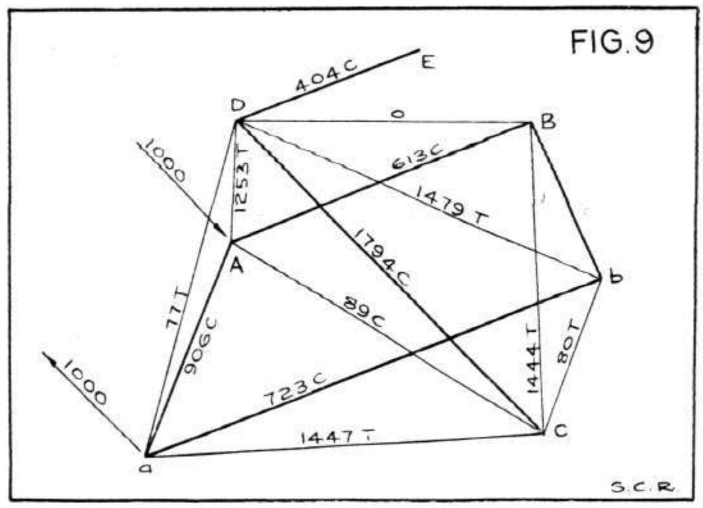
The solution of the eight equations is very rapid if quantities such as *t*AB, for example, which occur in one joint only, are eliminated.

For example :—

$$t\text{AB} = \tfrac{1}{2}\ (9t\text{AD} + 9t\text{AC} + 16t\text{A}a),$$

which can be substituted into the *x* and *y* equations of joint A. The complete solution follows progressively.

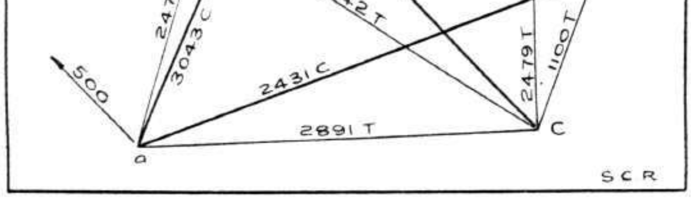
(*b*) *Torsion.* Owing to the lack of symmetry only one wire will be inoperative in this case. If a torque only is applied, as in Fig. 8, the member AC will have no load. It will be noticed that the member DE is in operation, although the net load in the *y* axis is zero,



the structure is subjected to an anti-drag moment, as joint A does not lie vertically above joint *a*. Members *a*D, C*b*, and DB receive almost negligible loads.

Now if the drag and torsion are to be combined, which is practically always the case, the above solution will not be valid. It will be remembered that one wire is always inoperative, a solution must therefore be obtained by putting *t*DB=O. The method of obtaining this solution is identical to that of the drag case, with the exception of the constant terms in the equations. Fig. 9 shows the loads in the structure when this solution is used.

It will be seen that the member AC has a small compression which is easily counteracted by the large tension from the drag case.



The drag and torsion loads are combined in Fig. 10.

The compressions in the verticals and booms of the spar have to be added to the loads obtained from the lift loads. As the wires intersect on the outside of the booms it is as well to stress the compression boom under its normal compression, together with an eccentrically applied end load from the pyramid bracing.

The loads in the members of one pyramid are carried on to the next, together with any additional external loads, and the process is then repeated.

It is impossible to cover all the difficulties which may occur by a single example, but it is hoped that the general method will indicate the lines on which the problem can be attacked with the least trouble.

APPLICATIONS OF THE POLAR DIAGRAM

By E. H. ATKIN, B.Sc.(Lond.)

(*Concluded from page* 71)

Let us pass on now to Bay No. 2.

$$\mu_{BL} = \sqrt{\frac{19{,}000}{3 \times 10^7 \times 2 \cdot 06}} = 0 \cdot 01753$$

$$\mu_{CR} = \sqrt{\frac{19{,}000}{3 \times 10^7 \times 1 \cdot 31}} = 0 \cdot 02197$$

$$\alpha_3 = 25 \times 57 \cdot 3 \times 0 \cdot 01753 = 25 \cdot 1^\circ$$

$$\alpha_4 = 65 \times 57 \cdot 3 \times 0 \cdot 02197 = 81 \cdot 8^\circ$$

giving a total angle of $106 \cdot 9^\circ$

Proceeding as for Bay No. 1 we obtain the following :—

and (ii) for

Bay No. 2 $\quad 19{,}000 \times 1 \cdot 708^2 \quad = \underline{61{,}750 \text{ lb.}}$

And the total angles are (i) for

Bay No. 1 $\quad 1 \cdot 708 \times 92 \cdot 55^\circ \quad = \underline{158^\circ}$

and (ii) for

Bay No. 2 $\quad 1 \cdot 708 \times 106 \cdot 9^\circ \quad = \underline{182 \cdot 7^\circ}$

In our more complicated problem it is not possible to achieve the generality obtained where bays having a constant moment of inertia are concerned; each case must be worked out afresh. If a case does arise which it is required to investigate for various ratios of end load the re-calculation of the tables given above may be avoided by the following artifice.

Still working in terms of the common multiplier K, assume that when $K = 1 \cdot 0$ Bay No. 1 has an end load P_1 and Bay No. 2 has an end load P_2

TABLE OF VALUES FOR BAY NO. 2

K	1·7	1·75	1·8	1·9
μ_{BL}	0·0298	0·0307	0·0315	0·0333
α_3	42·6°	43·9	45·2°	47·7°
α_4	139·0°	143·3°	147·3°	155·5
P_2	54,900	58,200	61,600	68,600
δ_2	− 9°	− 13·5°	− 19°	− 28·5°
Cot δ_2	− 6·3137	− 4·165	− 2·9042	− 1·8417
$\dfrac{\mu_{BL} \cot \delta_2}{P_2}$	$-0 \cdot 342 \times 10^{-5}$	$-0 \cdot 2198 \times 10^{-5}$	$-0 \cdot 1488 \times 10^{-5}$	$-0 \cdot 0893 \times 10^{-5}$
$\dfrac{1}{P_2 l_2}$	$0 \cdot 02023 \times 10^{-5}$	$0 \cdot 0191 \times 10^{-5}$	$0 \cdot 01805 \times 10^{-5}$	$0 \cdot 01622 \times 10^{-5}$
$\dfrac{\mu_{BL} \cot \delta_2}{P_2} + \dfrac{1}{P_2 l_2}$	$-0 \cdot 3118 \times 10^{-5}$	$-0 \cdot 2007 \times 10^{-5}$	$-0 \cdot 1308 \times 10^{-5}$	$-0 \cdot 0731 \times 10^{-5}$

A very instructive way of solving the instability equation from these figures, is to plot the following expressions against K

$$\text{viz :— (i)} \quad \frac{\mu_{BR} \cot \delta_1}{P_1} + \frac{1}{P_1 L_1}$$

$$\text{and} \qquad \text{(ii)} \quad -\left(\frac{\mu_{BL} \cot \delta_2}{P_2} + \frac{1}{P_2 L_2}\right)$$

Where these two curves cut will be the common value of K for the two bays at the instability point.

This has been done in Fig. 8.

ϕ is either of the expressions (i) and (ii)

K is found to be $1 \cdot 708$.

So that the end loads are (i) for

Bay No. 1 $\quad 10{,}500 \times 1 \cdot 708^2 \quad = \underline{30{,}700 \text{ lb.}}$

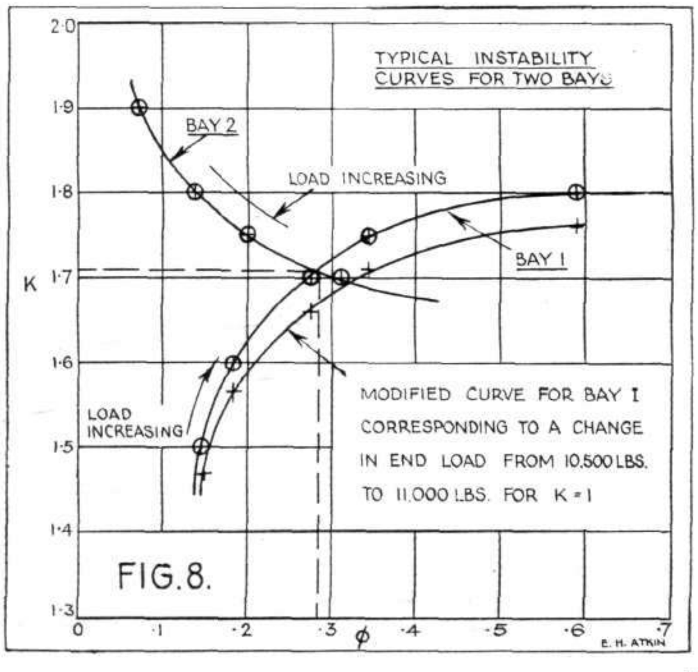


FIG. 8.

If now when $K = 1 \cdot 0$ the end load in Bay No. 1 is to be P_3 while the end load in Bay No. 2 is still P_2 the following relations must hold.

$$P = P_1 K_1^2 = P_3 K_3^2$$

Where P is the same end load in Bay No. 1 for both cases and K_1, K_3 are the multipliers for each case.

Whence

$$\frac{K_3}{K_1} = \sqrt{\frac{P_1}{P_3}}$$

from which it follows that the K ordinates of the curve are altered in a constant ratio.

This relation enables us to convert the values of K used for Bay No. 1 to another set of values corresponding to a certain change in the end load ratio of the two bays.

An example will make this clear.

Imagine that the end load in Bay No. 1 is to be 11,000 lb. (instead of 10,500 lb.) when the end load in Bay No. 2 is 19,000 lb. We transform the series of values of K_1 to a corresponding series K_2 by means of the relationship

$$K_2 = K_1 \sqrt{\frac{10{,}500}{11{,}000}}$$

$$\text{which} = \underline{0 \cdot 977 \, K_1}$$

Hence we have :—

K_1	1·5	1·6	1·7	1·75	1·8
K_2	1·465	1·563	1·66	1·71	1·76

and the same values of ϕ as before from which another curve for Bay No. 1 can be plotted as shown in Fig. 8, and another pair of end loads at instability deduced.

The use of the common factor K is just one of the ways by which the two bays can be correlated: there are, of course, other methods of tackling the problem.

The case of three bays, symmetrically spaced, stiffened, and loaded involves very little more labour than is required to deal with two bays and might well have been used to illustrate the theory. Perhaps the reader will be interested

enough to make up a typical case and work it out for himself. With this brief introduction the subject will be left.

It is hoped that the extensions and further applications of the polar diagram outlined in the foregoing sections will induce readers to study and make the fullest use of this ingenious method of beam analysis.

NOTES ON AIRSCREW-BODY INTERFERENCE

By W. R. ANDREWS,* A.F.R.Ae.S.

THE loss of overall thrust due to the combined effects of pressure gradient behind the airscrew and the slipstream over the body have been investigated by various experimenters.

The exact significance of the results obtained do not appear to have been fully appreciated.

The following notes are written to show how the results of the experiments can be used in synthetic estimates of aircraft performance.

In all the tests the expressions for relative body drag are in the form of

$$\frac{R_1}{R_o} = a_1 + b_1 T_c \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where R_o = Drag in free air without airscrew present

R_1 = Drag with airscrew running

$T_c = \frac{T}{\rho\sigma V^2 D^2}$ T = Thrust

V = Forward speed

D = Airscrew diameter

and ρ and σ have the usual significance.

This includes both pressure gradient and slipstream effects.

In a synthetic estimate of drag, "a" must equal 1·0 as the estimated drag of the parts is made for the case where the airscrew is present.

In any case experiments show that as the body drag increases, the value of "a_1" (in general) more nearly approaches unity.

Writing "a" = 1·0, the increase in drag due to interference is then

$$R_1 - R_o = R_o b T_c \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Now for R_o we may write

$$R_o = K_b \cdot \rho \cdot \sigma d^2 V^2 \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where d = body diameter

K_b = drag coefficient for body.

Substituting 3 in 2 gives

$$R_1 - R_o = bK_b \, \rho \, \sigma d^2 V^2 T_c$$
$$= bK_b \left(\frac{d}{D}\right)^2 T. \quad . \quad . \quad . \quad . \quad . \quad (4)$$

If this amount is taken from the free air airscrew thrust the "net" thrust is obtained, viz.,

$$\text{Net T} = T_F - (R_1 - R_o) = T_F\left[1 - bK_b\left(\frac{d}{D}\right)^2\right] \; . \; (5)$$

It has been shown (Ref. 1) that

$$b = K_1 + \frac{K_2}{K_b} \quad . \quad . \quad . \quad . \quad . \quad (6)$$

So that by substitution in (6) gives

$$\text{Net T} = T_F\left[1 - K_1K_b\left(\frac{d}{D}\right)^2 - K_2\left(\frac{d}{D}\right)^2\right] \quad . \quad . \quad . \quad (7)$$

If we write

$$K_b d^2 = hK_B S_w$$

where K_B = Total parasite drag coefficient for aeroplane in free air

h = Amount of K_B affected by slipstream

S_w = Wing area associated with K_B,

then

$$\text{Net T} = T_F\left[1 - \frac{K_1 h K_B S_w}{D^2} - K_2\left(\frac{d}{D}\right)^2\right] \quad . \quad . \quad . \quad (8)$$

which includes the usual "Slip factor" $\left[1 - \frac{K_1 h K_B S_w}{D^2}\right]$

and the pressure gradient factor $K_2\left(\frac{d}{D}\right)^2$ suggested by Mr. R. McKinnon Wood.

The "slip factor" has been in common use for some time, but the pressure-gradient effect seems to be neglected.

The value of the pressure-gradient factor is expressed in R. & M. 1046 as an approximation :

$$\Delta R = \tfrac{1}{2}\left(\frac{d}{D}\right)^2 T.$$

The mathematical solution for the slip factor is given in full, as uncertainty seems to exist as to how this result is obtained.

Let forward speed = V· f.p.s.

Let slipstream speed = V + v.

By the vortex theory it has been shown that the ratio of inflow to outflow is 0·5, so that the velocity through the airscrew disc is $V + \frac{1}{2} v$.

The quantity of air passing per second is

$$Q = \rho\,\sigma \cdot x \cdot D^2\,(V + \tfrac{1}{2}v) \quad . \quad . \quad . \quad . \quad . \quad (9)$$

Where $x \cdot D \cdot ^2$ = effective disc area of airscrew. The change in momentum is "v," so that the energy developed per second in the slipstream is

$$T = \rho \cdot \sigma \cdot x \cdot D^2 \cdot v \cdot (V + \tfrac{1}{2} v)$$

$$\therefore\; (2V_v + v^2) = \frac{2T}{x \cdot \rho\sigma\, D^2} \quad . \quad . \quad . \quad . \quad . \quad (10)$$

The parasite drag affected by slipstream is

$$R_o = hK_B \cdot \rho\,\sigma S_w\, V^2 \quad . \quad . \quad . \quad . \quad . \quad (11)$$

Similarly,

$$R = h \cdot K_B \cdot \rho\,\sigma \cdot S_w \cdot (V + v)^2 \quad . \quad . \quad . \quad . \quad . \quad (12)$$

Therefore the increase in drag due to slipstream is

$$R - R_o = h \cdot K_B \cdot \rho \cdot \sigma \cdot S_w \cdot [(V + v)^2 - V^2]$$
$$= h \cdot K_B \cdot \rho \cdot \sigma \cdot S_w \cdot [2V \cdot v + v^2]$$

Substituting for $(2V_v + v^2)$ from (10) gives

$$R - R_o = h \cdot K_B \cdot S_w \cdot \frac{2T}{xD^2} \quad . \quad . \quad . \quad . \quad . \quad (13)$$

which is similar to the slipstream loss included in equation (8), where

$$K_1 = \frac{2}{x} = \frac{8}{\pi} \quad . \quad . \quad . \quad . \quad . \quad (14)$$

This assumes the whole of the airscrew disc as being effective.

The value of x is generally accepted as $\frac{8}{9} \cdot \frac{\pi}{4} = 0 \cdot 7$ on the assumption that the middle third of the airscrew is ineffective.

Thrust grading curves (Reference 2) show that generally the thrust reverses in value at about 0·25 to 0·3 the maximum radius of the airscrew, so that this assumption seems reasonable.

Accepting this value for disc area gives

$$K_1 = 2 \cdot 86 \quad . \quad . \quad . \quad . \quad . \quad (15)$$

In R. and M. 1030 (Reference 3), the effect of adding various excrescences to a streamline body has been investigated.

The excrescences have been added at different positions along the body.

Since the size of the body has remained sensibly the same for all cases the pressure gradient effect will also be sensibly constant, so that the increase in drag from one case to another is due wholly to the slipstream speed over the body.

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Starting with equation

$$\frac{R}{R_o} = a + b. \quad T_c = \frac{K_b}{K_{b_o}} \quad . \quad . \quad . \quad . \quad . \quad (16)$$

then the addition of an excrescence will increase K_b to $K_b + \Delta K_B$ without altering " a," we hope.

To keep the mean value of R/R_o the same when " a " is made unity, " b " is adjusted to give the same value of R/R_o at $T_c = 0 \cdot 25$, so that when " a " $= 1 \cdot 0$ we may write

$$\Delta R = \Delta K_b \cdot \frac{2}{x} \cdot \left(\frac{d}{D}\right)^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (17)$$

and it follows that

$$b_2 = \frac{b \cdot K_b + \Delta K_b \cdot \frac{2}{x}}{K_b + \Delta K_b}$$

from which

$$\frac{2}{x} = \frac{b_2\,(K_b + \Delta K_b) - bK_b}{\Delta K_b} \quad . \quad . \quad . \quad . \quad (18)$$

For the streamline body without excrescences, $b = 13 \cdot 3$ and $K_b = 0 \cdot 0258$, so that for any other case

$$\frac{2}{x} = \frac{b_2\,(0 \cdot 0258 + \Delta K_b) - 13 \cdot 3 \times 0 \cdot 0258}{\Delta K_b}$$

$$= \frac{b_2 K_{b_2} - 0 \cdot 343}{\Delta K_b}$$

The results are shown in the following Table.

—	Annulus at 1·0 D.	8 Large Segments at 1·0 D.	4 Large Segments at 1·0 D.	2 Large Segments at 1·0 D.	2 Small Segments at 1·0 D.	Annulus at 1·5 D.
Data from R. and M. 1046						
K_b	0·0936	0·123	0·0674	0·0495	0·0652	0·0806
a	1·0	1·1	1·0	1·05	1·05	0·98
b	6·1	4·64	7·0	8·1	6·87	6·94
Adjusted values of " b " when $a = 1 \cdot 0$	6·1	5·04	7·0	8·3	7·07	6·86
$b \cdot K_b$	0·57	0·62	0·471	0·410	0·461	0·553
ΔK_b	0·0562	0·0856	0·03	0·012	0·0278	0·0432
$\frac{2}{x}$	3·37	3·24	3·08	3·14	3·25	3·72

The mean value of $\frac{2}{x}$ for those experiments with the excrescences at 1·0 D behind the airscrew is 3·21.

This suggests an effective disc area of $0 \cdot 79 \frac{\pi}{4} D^2$.

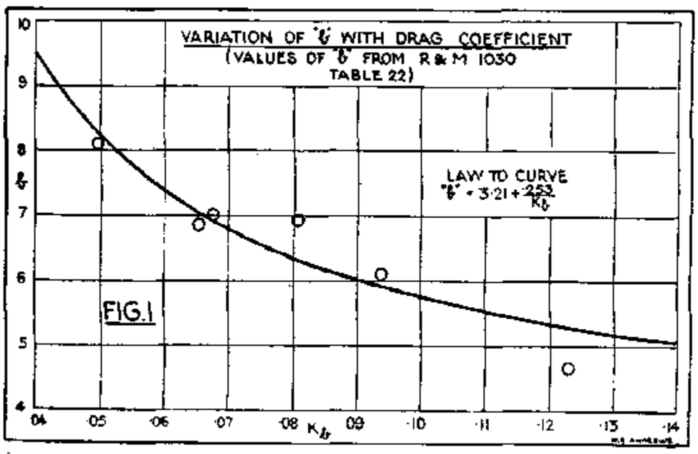


FIG.1

Unfortunately, the necessary data for the cases where the annulus is at 0·125 and 0·5 D are not included in the report, but it would be expected that as one approaches the airscrew the value of $\frac{2}{x}$ obtained from the test results as above would decrease.

It is not possible to separate the slipstream effect and the pressure gradient effect on the streamline body alone, but there will be no loss of generality by combining the two effects since both are dependent upon $\left(\frac{d}{D}\right)^2$.

The pressure gradient effect + minimum slipstream effect is then found from $K_b\,(b - 3 \cdot 21)$, which shows an average value of 0·253, or about ½ the pressure gradient effect alone suggested by theoretical considerations for a body extending over the whole length of the pressure gradient.

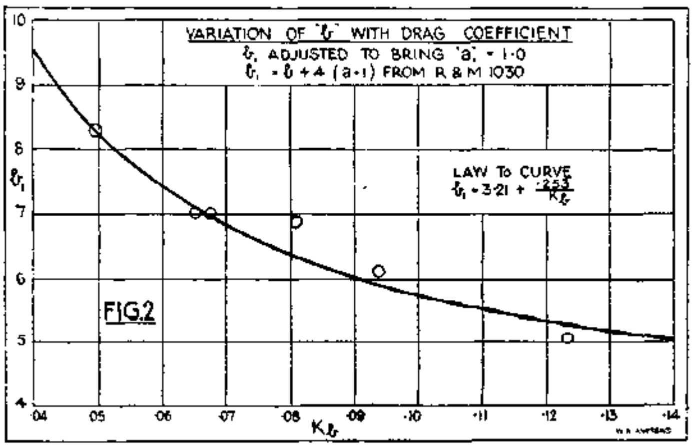


FIG.2

The attached curves show the agreement of the above results with the observed and adjusted values of " b."

The revised formula for nett efficiency then becomes (when the major drag is about 1 diameter behind the airscrew)

$$\frac{\eta_2 \text{ nett}}{\eta \text{ free}} = 1 - \frac{3 \cdot 21\; h \cdot K_b \cdot S_m}{D^2} - 0 \cdot 253 \left(\frac{d}{D}\right)^2 \quad . \quad . \quad . \quad . \quad (19)$$

Further data is required to show clearly how the constant of 3·21 is modified by proximity of the major drag to the airscrew, such as in the case of a radial engine in front of a fuselage.

It is fairly obvious that an obstruction immediately behind the airscrew at a smaller radius than 0·25 R*m* will not be affected by the slipstream.

The nearer to the tip the obstruction is placed, the greater will be the loss of thrust due to the slipstream over the part.

As an obstruction at some particular radius is moved away from the airscrew, the slipstream effect will be more pronounced.

Eventually a point (at probably 1·5 D) is reached where the effect is a maximum, after which the loss of thrust will fall off with increasing distance.

This is partly due to the ineffective centre of the airscrew, and partly to the speed increment at the airscrew being only half that of the maximum slipstream speed increment.

It is probable that the loss of thrust due to the slipstream effect over a radial engine fitted to the nose of a fuselage is equivalent to about ½ of the engine drag placed at the point of maximum slipstream velocity.

Until further data is available, the discretion and experience of the operator must be relied upon in deciding such points.

REFERENCES

(1) R. & M. 1046.—The effects of body interference on airscrew performance.—W. G. Jennings, B.Sc.

(2) R. & M. 892.—Experiments with a family of Airscrews. Part III. C. N. H. Lock, M.A., and H. Bateman. B.Sc., A.C.G.I., D.I.C.

(3) R. & M. 1030.—Experiments with a family of Airscrews, including effect of tractor and pusher bodies. Part IV. H. Bateman, B.Sc., A.C.G.I., D.I.C., H. C. H. Townend, B.Sc., and T. A. Kirkup.

TECHNICAL LITERATURE

SUMMARIES OF AERONAUTICAL RESEARCH COMMITTEE REPORTS

These Reports are published by His Majesty's Stationery Office, London, and may be purchased directly from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, W.C.2; 120, George Street, Edinburgh; York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 15, Donegall Square West, Belfast; or through any Bookseller.

THEORY OF AIRSCREW BODY INTERFERENCE. APPLICATION TO EXPERIMENTS ON A BODY OF FINENESS RATIO 3 : 0 WITH TRACTOR AIRSCREW. By C. N. H. Lock, M.A. R. & M. No. 1378. (23 pages and 10 diagrams.) May, 1931. Price 1s. 3d. net.

In R. & M. 1120,* 1238,† and 1239‡ a method was developed of calculating the effect on performance of housing a tractor airscrew in the nose of a body whose shape is an exact spheroid. The first part of the experiments described in R. & M. 1380§ relates to a tractor airscrew and a body (fineness ratio 3·0), of which the forward half is an exact spheroid; calculations of performance based on the above method were therefore made and compared with these experimental results. The present report includes a complete account of the theoretical method employed.

A comparison of thrust grading curves at radius $x = 0 \cdot 3$ suggests that this section in the airscrew has a maximum k_L of at least 1·2, as compared with the value 0·55 observed on the aerofoil. After allowance has been made for this, the agreement between theory and observation is, in general, satisfactory.

Analysis of the drag observations in conjunction with those on a body of fineness ratio 5·45 (R. & M. 1030,‖ 1230¶) indicates a "spoiling effect" (additional to the expected effect of slipstream velocity) amounting to about 4 per cent. of the thrust near maximum efficiency, but at larger thrusts this is partly offset by an increase in the effective efficiency of the airscrew. This spoiling effect is very roughly the same for both bodies, and also when the drag of the bodies is artificially increased by adding excrescences.

The observations at static on the short body with annulus indicate a spoiling effect rather smaller than would be predicted from the observations over the normal working range, but this discrepancy amounts to only 2 per cent. of the thrust.

The method of drag analysis used here has since been partly superseded by the simplified method of R. & M. 1445**, which is also applicable to pusher airscrews, and does not require observations of pressure over the nose or strip theory calculations of airscrew performance.

* R. & M. 1120.—Analysis of experiments on an airscrew in various positions within the nose of a tractor body.—Lock.

† R. & M. 1238.—Note on the effect of body interference on the efficiency of an airscrew.—Lock.

‡ R. & M. 1239.—The application of the theoretical velocity field round a spheroid to calculate the performance of an airscrew near the nose of a streamline body.—Lock.

§ R. & M. 1380.—Pressure and force measurements on airscrew-body combinations.—Bateman and Johansen.

‖ R. & M. 1030.—Experiments with a family of airscrews, including effect of tractor and pusher bodies. Part IV. On the effect of placing an airscrew in various positions within the nose of a streamline body.—Bateman, Townend, and Kirkup.

¶ R. & M. 1230.—Pressure plotting a streamline body with tractor airscrew running.—Lock and Johansen.

** R. & M. 1445.—Analysis of experiments on the interference between bodies and tractor and pusher airscrews.—Lock and Bateman.

EFFECT OF SIDESLIP ON THE PERFORMANCE OF A MULTI-ENGINED AIRCRAFT. By E. T. Jones, M.Eng. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1455. (6 pages and 4 diagrams.) January, 1932. Price 6d. net.

The performance of a multi-engined aircraft with one engine fully throttled has been measured with and without bank to determine the order of the loss of performance which may result from flying with sideslip when an outboard engine has failed.

The rate of climb of a three engine-in-line and a twin-engined flying boat has been measured at the best climbing speed for angles of bank from − 10 deg. to + 10·0 deg. with an outboard engine fully throttled. The corresponding angles of sideslip have been calculated.

The optimum rate of climb which should be obtained when the sideslip is zero is only slightly diminished within the limits ± 4 deg. of sideslip; outside these limits the loss of performance increases rapidly as the amount of sideslip increases. The amount of sideslip with ailerons neutral which is required to balance the side force on the rudders when an outboard engine is fully throttled is of the order of 5·5 deg. for the particular three-engined aircraft tested.

A MEMORANDUM GIVING A SUMMARY OF PRESENT KNOWLEDGE ON THE RELATION BETWEEN GROUND CONTOURS, ATMOSPHERIC TURBULENCE, WIND SPEED AND DIRECTION. By W. R. Morgans, M.Sc. Communicated by the Director, Meteorological Office. R. & M. No. 1456. (39 pages and 28 diagrams.) December, 1931. Price 2s. 3d. net.

The author has collected information published by a large number of workers, especially from Germany, where considerable attention has been paid to the subject He discusses separately the height and horizontal distance of influence of obstacles, a theoretical treatment of the flow of air over a mountain, a comparison of this theory with experimental results, eddies in the neighbourhood of obstacles, the effect of coasts, vertical velocities and the lapse rate of temperature and some general problems arising from the memorandum.

The evidence drawn from a comparison of experimental with theoretical work shows that:—

(a) Although the maximum velocity of the wind may occur at the summit it is not entirely horizontal. In the work of Koschmieder vertical velocities appear above the summit.

(b) The vertical velocity is a maximum above the middle of the slope and is given, in the steady state, by $w = V_0 \tan a$.

(c) The vertical velocity does not decrease with height everywhere, but in all the experiments shows, at some points, first a gradual increase with height and then a gradual decrease.

(d) The curves of equal ascending and descending velocities are not symmetrical with respect to the vertical through the summit, but that to leeward a region of turbulence occurs. The field to leeward differs essentially from that to windward.

(e) The height of influence for extended dunes, which correspond to an infinitely extended obstacle transverse to the wind, give much higher heights of influence than isolated obstacles.

But these experiments when compared among themselves point to the important conclusion that with wind velocities below a critical velocity of approximately 10 m/s. a comparatively steady state is obtained to windward, but that with wind velocities above the critical value, space time changes in the velocity field occur indicative of turbulence and of which little appears to be known.

The author also remarks that if, with wind velocities below 10 m/s., stationary eddies exist, and with velocities above 10 m/s., turbulence, then any theory depending on streamline flow can have no application to the flow of air over obstacles.

THE INTERFERENCE ON THE CHARACTERISTICS OF AN AEROFOIL IN A WIND TUNNEL OF RECTANGULAR SECTION. By H. Glauert, F.R.S. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1459. (7 pages and 1 diagram.) February, 1932. Price 6d. net.

Formulæ for the interference on the characteristics of an aerofoil in a wind tunnel of rectangular section, based on the author's approximate theory (Ref. 1), have been known and used for several years. More recently, attempts have been made to increase the accuracy of these formulæ by a closer analysis of the problem. Terazawa (Ref. 2) has developed the analysis rigorously for an aerofoil with constant circulation across its span, and has determined the mean value of the induced velocity experienced by the aerofoil. Rosenhead (Ref. 3) has repeated Terazawa's analysis for uniform loading, obtaining the same result but in a very different mathematical form, and he has also developed the corresponding analysis for an aerofoil with elliptic distribution of lift across the span. These authors have not deduced general numerical values from their formulæ, and indeed Rosenhead's formulæ are not suitable for numerical computation unless the span of the aerofoil is only a small fraction of the width of the tunnel. In this paper the formulæ given by Terazawa and Rosenhead are examined, then recast into a form suitable for direct numerical computation, and the numerical results are derived for the two shapes of practical interest, the square and the rectangle, whose width is double its height. The correction to the approximate formula is comparatively unimportant for a square tunnel, but important for a duplex tunnel.

THE INDUCED FLOW THROUGH A PARTIALLY CHOKED PIPE WITH AXIS ALONG THE WIND STREAM. By H. Glauert, F.R.S., D. M. Hirst, M.A., and A. S. Hartshorn, B.Sc. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1469. (15 pages and 5 diagrams.) March, 1932. Price 1s. net.

In connection with cooling problems, it was desired to know the flow which would be induced through a duct lying in a stream of air, and the relationship between this flow and the pressure difference between the two ends of the duct. Since no information on this subject was available, a few simple experiments have been made with some smooth straight pipes of external diameter of 1·5 in., containing various gauze obstructions at their mid-sections.

The induced flow can be derived from a theoretical formula, if allowance is made for the small suction at the outlet, which depends mainly on the length of the pipe. For a given pressure difference between inlet and outlet the induced flow decreases as the pipe is lengthened. The drag coefficient of a gauze disc depends not only on the blocked area, but also to a lesser extent on the diameter of the wires forming the gauze.

SOME GENERAL THEOREMS CONCERNING WIND TUNNEL INTERFERENCE ON AEROFOILS. By H. Glauert, F.R.S. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1470. (11 pages and 6 diagrams.) April, 1932. Price 9d. net.

When an aerofoil is tested in a wind tunnel the finite extent of the stream modifies the whole nature of the flow, and it is necessary to apply certain corrections to the observed forces in order to derive those which would be experienced in an unlimited stream. The general basis of these corrections has been laid down by Prandtl.* In a closed tunnel with rigid walls, the necessary boundary condition is that the component of the velocity normal to the walls shall be zero, and in an open tunnel or free jet the condition is that the pressure shall be uniform over the boundary.

In the present paper two general theorems are proved:—(1) The interference on a very small aerofoil in an open tunnel of any shape is of the same magnitude, but opposite sign as that on the same aerofoil, rotated through a right angle, in a closed tunnel of the same shape. (2) The interference velocity, is uniform across the span of an aerofoil in any elliptic tunnel having the tips of the aerofoil as foci.

The following general conclusion is of importance:—For tests of large aerofoils, it is desirable that the interference shall be constant along the span in order to avoid any distortion of the distribution of lift. This condition is satisfied by a confocal elliptic tunnel, whether closed or open, but as the magnitude of the interference is less in a closed tunnel, this type is to be preferred for tests of large aerofoils.

* Tragflügeltheorie II, Gött. Nach (1919).

AIRPORT NEWS

CROYDON

SOME fast journeys were accomplished during the week by several air liners, the first being on Monday, October 17, when Capt. Walters, of Imperial Airways, flew the 12.30 p.m. 42-seater from Croydon to Paris in 92 min., the schedule time being 2 hr. 15 min. The inward machine from Paris made the journey in approximately 2 hr. 45 min., despite unusually strong head winds. There was a stretcher case on board.

On Tuesday, Capt. Wilcockson piloted the "Hengist," which was the 12.30 p.m. to Paris, covering the distance in 85 min., and thus beating the previous day's record by 7 min.

The S.A.B.E.N.A. machine also made a quick trip from Croydon to Brussels in 85 min., and the same evening the German night freight machine made the journey to Cologne in 2 hr. 3 min. All S.A.B.E.N.A. machines to leave Croydon throughout the week have been full to capacity with passengers and freight.

The "Fox Moth" G-ABUT, this year's winner of the King's Cup air race and the only "Fox Moth" fitted with a Gipsy Major engine, was hired from Surrey Flying Services, Ltd., by the de Havilland Aircraft Co., Ltd., on behalf of H.R.H. Prince George on Wednesday. Flt. Lt. Fielding flew the machine from Croydon at 8.30 a.m. to Stag Lane, where the Prince boarded the plane for Bournemouth.

The same morning Mr. Henry Cotton, the famous golf champion, took his first lesson in flying. His instructor was Mr. S. F. (Timber) Woods, of S.F.S. Mr. Cotton's object is to obtain his "A" licence and then to purchase his own machine, which he will fly between London and Brussels, where he has a number of engagements to fulfil.

The Maharajah of Jodhpur, who is keenly interested in aviation, and is himself a first-class pilot, paid an informal visit with his suite to the aerodrome on Thursday, where he inspected the workshops of the Cirrus-Hermes Engineering Co., Ltd., and flew in the Percival "Gull," and also a Monospar, of General Aircraft, Ltd.

Unfavourable weather towards the end of the week interfered to some extent with the running of the 5 p.m. Imperial Airways service to and from Paris, which caused them to be cancelled both ways on Wednesday and Thursday. There was a 30-40-mile-an-hour wind on Friday and poor visibility over most of the route, a south-westerly gale was expected in the Channel, consequently the services were again cancelled. The 5 p.m. service on Saturday was operated from Paris, but not the outward service, due to an area of low cloud and rain moving from the north-west in a south-easterly direction, and calculated to reach Paris about the same time as the air liner had it proceeded.

Imperial Airways are, however, experiencing an unprecedented number of passenger bookings for the time of the year. There were 44 passengers for the 12.30 p.m. service on Saturday, and an extra 42-seater machine was used to supplement the service. Amongst the passengers on these machines were the American film star, John Gilbert, and his wife, Virginia Bruce. Lord Erskine's daughter and son-in-law also left on their way to Iraq.

Mr. Robertson, the aviation manager of the Dunlop Rubber Co., visited the aerodrome on Saturday, when he informed me that he is well satisfied with the "Puss Moth" his firm provided him with. It is proving itself a time- and money-saver.

Mr. Robert W. Montgomery, who has learned to fly with Rollason, Muir & Rickard, and obtained his "A" licence about six weeks ago, left on Friday for a short visit by boat and train to his home in Ireland. He has recently made some long cross-country flights, and is rapidly getting his time in for his "B" licence. He is hoping to fly to Ireland on his next visit.

Mr. Wright made his first solo flight in his Bristol "Fighter" on Wednesday to Gatwick return. He was very pleased with the behaviour of the machine.

On Saturday a K.L.M. Fokker, F.12, landed at Croydon from Baldonnel, Dublin, on its way with passengers and mail to Berlin. It was met by the High Commissioner in London for the I.F.S.

The total number of passengers for the week was 1,483; freight, 53 tons 9 cwt.

HORATIUS.

FROM HESTON

ON Monday, October 17, Sir Alan Cobham arrived at Heston with his "Airspeed Ferry" (G-ABSJ). He gave a demonstration of its performance. Personal Flying Services, Ltd., Junkers G-ABDC was engaged by Lord Charnock to make a tour of several old castles in Kent, with the idea of ascertaining their aspect from the air.

Wednesday, October 19, was a nice flying day as regards instruction. Airwork School of Flying had one machine off at 8.30 a.m. to Cowes, Isle of Wight, while another was engaged for two hours on photographic work during the morning. The Monospar of the Portsmouth, Southsea & Isle of Wight Aviation, Ltd., arrived with an American honeymoon couple who had that afternoon arrived in the *Aquitania*.

Thursday, October 20, gave the Flying School quite a ladies' morning—all the pupils before lunch being ladies. One machine (Desoutter) cleared Customs and left at 7 a.m. for Paris. Mrs. Mansfield Markham left on her "Avian" VP-KAN for her return flight to Kenya. Mr. Jackaman arrived late in the afternoon, having flown from Teignmouth with Lady Bailey and Mrs. Westernra as passengers.

Friday, October 21.—Birkett Air Service opened up at Heston Airport to-day. One machine ("Moth") cleared Customs and left for Brussels. Two machines cleared inwards—one "Fox Moth" from Brussels and one "Moth" from Paris. Customs started early on Saturday, October 22, as one Klemm cleared at 7.30 a.m. and left for Paris *en route* for Cannes. Capt. Birkett soon commenced operations with his air service, leaving at 9 a.m. with one passenger for Amsterdam. On Sunday, October 23, a Monospar was delivered to Brian Lewis & Co. as a demonstration machine, they being the Monospar agents at Heston Airport.

Airwork, Ltd., have decided, in order to encourage flying during the winter months, to reduce the dual and solo flying rates to £3 3s. per flying hour for the months of November and February.

Misr-Airwork of Heliopolis, Egypt, an associated company of Airwork, Ltd., who have made great strides since their formation, arranged a two-days' flying meeting at Alexandria recently. This venture was an unqualified success, many people taking advantage of the occasion to fly from the Dekeila Civil Aerodrome at Alexandria to Abukir and back. Many desirous of taking joy flights and trips to Abukir had to be turned away, and, in order to lessen the disappointments, one machine was left for a third day to accommodate as many as possible.

An American Visitor

OUR readers will be interested to learn that Mr. Edward P. Warner, the Editor of our American contemporary, *Aviation*, is shortly paying a visit to this country. Together with Mrs. Warner, he will be arriving on the *President Harding* on November 3, and staying a week before going over to the Continent. Letters to meet him on arrival should be addressed care of the Guaranty Trust Co., 50, Pall Mall. Mr. Warner was previously an Assistant Secretary of the Navy.

AIRISMS FROM THE FOUR WINDS

"Graf Zeppelin"

Having completed last week her return journey from Brazil to Friedrichshafen, carrying the record number of 40,000 letters, the German airship *Graf Zeppelin* left Friedrichshafen on October 24 on her ninth flight this year to Brazil; Col. the Master of Sempill was one of the passengers. The *Graf Zeppelin* has now completed 500,000 km. (310,700 miles), crossed the Atlantic 30 times and carried 7,500 passengers.

The Bibesco Cup

The Bibesco Cup, offered for the fastest time between Rome and Bucarest, has been won by two Roumanian officers on a French Potez 50 machine fitted with Gnome-Rhone 14 K brs. engine. The machine was piloted by Capt. Botez and Chief Adjutant Manolescu, the distance of approximately 1,200 km. (746 miles) being covered in 4 hr. 6 min. 18 sec., or at an average speed of 277.7 km./h. (172 m.p.h.). The machine was the same on which recently two world's records for speed with useful loads of 500 kg. and 1,000 kg. were established.

Ottawa-Mexico City

An American pilot has recently established a record flight between Ottawa and Mexico City, having covered the 2,400 miles in 11 hr. 53 min.

Com. G. Rodd's Accident

His many friends will be glad to hear that Com. Rodd, who was thought to have cracked his skull in a fall, has not done so. His injury is confined to concussion and bruises and it is hoped that his recovery, at present proceeding satisfactorily, will soon be complete.

Moritz Dornier Dead

Herr Moritz Dornier died on October 18 at Münich after an operation necessitated by an illness incurred by him during his service in the German East African campaign. He was the brother and collaborator of Dr. Claudius Dornier, the head of the Dornier aircraft construction works of Friedrichshafen.

Air Touring in European Countries

The Royal Aero Club has been requested to draw attention to the trouble and delay caused through air tourists not being furnished with the necessary permits for flights in or over certain European countries. Permits are necessary in the following countries:—Turkey, Russia, Finland, Spain, Jugcslavia, Latvia, Luxemburg, Lithuania, Esthonia, Austria, Hungary, Poland, Bulgaria. The Touring Department of the Royal Aero Club will give information on all touring matters, supply carnets and maps, and obtain permits where necessary.

"Air Delivery Van" Flies to Scotland

The aerial goods delivery service inaugurated recently by J. S. Fry & Sons, of Somerdale, Somerset, for use in rush emergency orders, was called into action once more by a Glasgow firm on Monday (October 17). The machine, a three-seater D.H. "Puss Moth," piloted by Mr. C. W. A. Scott, the well-known airman, left Somerdale with a 210-lb. consignment of chocolates for Messrs. Methven's, the Glasgow confectioners. Despite head and cross winds, Mr. Scott completed the journey in 3 hr. 40 min. He landed at Renfrew Aerodrome and was welcomed by Mr. T. Wishart, Fry's supervisor in Glasgow, and Mr. Robertson of Methven's. This is the first flight Mr. Scott has made for Fry's since the inauguration of their express air delivery service, but the Fry aeroplane has had to make several emergency flights to different parts of England. Mr. Scott's flight, however, was by far the longest which the "air delivery van" has had to make.

Spartan Progress

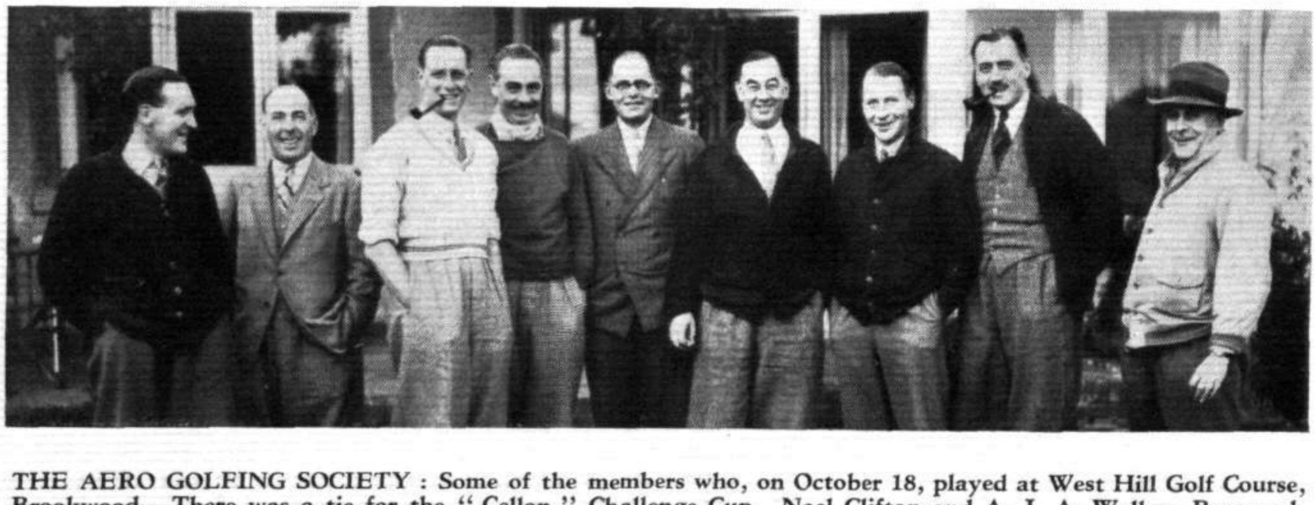
The Spartan "Cruiser" (three Gipsy III), as already announced in Flight, is at present carrying out a demonstration in Central Europe with Athens as its ultimate destination. The pilot is Col. Louis Strange and his passengers Mr. John Lord and Mr. J. de C. Ballardie (directors of Spartan Aircraft). As is to be expected at this time of year the weather has been against them, and after leaving this country they were held up for three days in Paris. Being a three-engined machine, however, with the attendant safety of the type, they at last decided to push on, and flew non-stop from Paris to Münich in 3 hr. 10 min. on Monday, October 17. The next day making another non-stop flight of 3 hr. 50 min. from Münich to Belgrade. On this journey they were fortunate enough to encounter a tail wind, but low clouds during the whole trip made it somewhat "sticky," particularly over the Black Forest, while near Münich a "man-sized" line squall was struck. After the Alps and Salzburg, however, things began to clear, and from then on a hot sun with blue sky was encountered all the way to Belgrade.

Motor Show Hospitality

Many firms in the motor trade now have aviation interests, and the two trades are therefore rapidly becoming quite closely linked. So much so that the hospitality shown during the motor show is now, by many firms, extended to aeronautical customers and agents as well as to their motoring friends.

On Thursday, October 13, there was the Exide Lunch. This is now an established prelude to the first day at the show, and this visit to the Clarendon Restaurant has become an annual meeting place for a very wide circle of the many friends of the company. This year the attendance was even greater than ever. Mr. Dunne, the Managing Director of the Company, was in the chair, and in his speech he voiced a plea for less interference on the part of politicians in the activities of individuals in commerce. He cited an example of what occurred at Ottawa. Here it was agreed that batteries having plates ¾ in. thick should be allowed to be imported into Canada free of duty. This dimension, it would appear, rules out 99.99 per cent. of the batteries made in the world!

On October 18 Henlys held their ball at the Mayfair Hotel. A sumptuous affair and strongly attended by both the motoring and aviation fraternity. Of the latter there were not only professional pilots and agents, but also flying club members from as far north as the Northamptonshire Aero Club. An excellent cabaret was included in the programme and the directors of Henlys are to be congratulated upon the success of their party.



THE AERO GOLFING SOCIETY: Some of the members who, on October 18, played at West Hill Golf Course, Brookwood. There was a tie for the "Cellon" Challenge Cup. Noel Clifton and A. J. A. Wallace Barr each returned 86 less 4 = 82. The four-ball foursomes was won by Noel Clifton and the Hon. Brian Lewis 9 up on bogey. In our group are included, from left to right, Messrs. Barnard, Keith Davies, Wallace Barr, Noel Clifton, Roberts, Hazell, Brian Lewis, Alston and Perrin. (Flight *Photo.*)

AIR TRANSPORT

PROGRESS IN BRITISH CIVIL AVIATION

LT. COL. F. C. SHELMERDINE, Director of Civil Aviation, delivered a most interesting lecture on the above subject before the R.U.S.I. on Wednesday, October 19. In starting, he reminded his audience that the late Sir Sefton Brancker, his predecessor, had been in the habit of delivering lectures before the Institution at approximately two-year intervals, and he felt, therefore, that his own lecture was really a continuation of this series. Speaking of subsidies, Col. Shelmerdine drew attention to the fact that practically all the scheduled regular air services throughout the world were to-day subsidised, either directly or indirectly, by the Governments concerned and in this country, the aim in view in subsidising Imperial Airways had been to enable that company to place air transport on a self-supporting basis at the earliest possible date.

He then enumerated the agreements with Imperial Airways, and stated that in return for the subsidy the company had to complete each year a minimum of 425,000,000 horse-power miles over certain subsidised routes. He pointed out that during the year ended March 31, 1932, the total flown was 865,347,975 horse-power miles. [The actual details of these subsidy agreements have already been placed before our readers in our pages, and it is not therefore necessary to recapitulate them here.—ED.] A table was given showing the figures for direct subsidies for the year 1931-32 in various countries (taking the exchange rates at par). Great Britain was £520,000; France, £1,580,000; Germany, £920,000; Italy, £768,000; Holland and Dutch East Indies, £310,000; Belgium, £163,000; Poland, £145,000; Czechoslovakia, £137,000. Turning to the Continental services, Col. Shelmerdine said that the number of passengers carried had steadily increased, and during the first eight months of this year was 84 per cent. greater than the number carried during the corresponding period last year.

Details were also given of the fares of all the Continental routes and the services run, not only by Imperial Airways, but also by the Air Union, K.L.M., Luft Hansa and Sabena. An interesting fact was that the percentage of passengers carried in British machines was 48 per cent. of the total. The value of bullion and other goods imported by air has, of course, steadily increased, there being over two million pounds worth of goods (exclusive of bullion) imported during 1931.

Turning to the service to India, Col. Shelmerdine first of all made reference to the I.C.A.N. and to the aims and objects of that body. He referred in particular to the interpretation of Article 15, which provides that "the establishment of international airways shall be subject to the consent of the States flown over." We, on our part, contended that the use of the term "Airways" and not "Air Services" indicated that the latter are not subject to permission, but that the consent of the States flown over refers only to the establishment of the ground organisation which constitutes the airway. Other countries, however, maintained that it was intended to make operation of air services definitely subject to the permission of the States flown over, and that no other interpretation could be admitted. At the extraordinary session of the I.C.A.N., held in Paris in July, 1929, the British representative pressed the matter to a vote, with the result that 27 States considered that no air line should be established without the authorisation of the States flown over. Only four (the British Empire, U.S.A., Netherlands and Sweden) recorded in favour of the freedom of the air. We could only hope, therefore, that these artificial barriers to the natural development of aviation would gradually be broken down and that complete freedom would eventually be possible.

Following on, Col. Shelmerdine then recorded the history and growth of the England-India Air Route. He drew attention to the fact that our original agreement with the Persian Government had now expired, and as the chances of obtaining a long-term agreement appeared remote, it was decided to transfer operations to the Arabian side of the Persian Gulf, using landing grounds at Bahrein, Yas Island and Shargah.

Full details of the service to Capetown were then given, starting from as far back as December, 1918, when, at the instigation of Sir Geoffrey Salmond, who was then Air Officer commanding the Middle East, three Ground Survey Parties were despatched from Egypt with the object of selecting and preparing aerodromes and generally organising the air route from Cairo to the Cape. The route as it now is was gone through in full and the results achieved, particularly with regard to the collection of mail, given extensively. The feeder routes which have already been established, such as that of the Sabena from Elizabethville (Belgian Congo) to Broken Hill (Northern Rhodesia), were also dilated upon and the hope expressed that other routes, for example between Salisbury and Blantyre (Nyassaland) and Salisbury and Beira (Portuguese East Africa), would be established shortly.

Future developments were touched upon, and the hope of the British Government expressed, to see the present route to India extended across India through Burma, Malaya and the Dutch East Indies, to Australia. Col. Shelmerdine said that negotiations were already in hand with a view to extending the service by means of joint operation with an Indian company and Imperial Airways over the section Karachi-Singapore, while Singapore-Australia, it was hoped, would be undertaken by Australian interests. This service it was confidently hoped to inaugurate in 1933.

The possibility of a Trans-Atlantic air mail service was also mentioned, and the three main routes discussed, the first being the Great Circle route, via Ireland and Newfoundland, the second the Sub-Arctic route via Greenland and Iceland, and the third the Southern Route via Lisbon, Azores and Bermuda to New York. A suggestion which seemed to have possibilities, particularly in utilising to the best advantage the weather conditions, was that flying westwards, the Southerly Route might be used and flying eastwards the Great Circle route would be followed. We were told that consideration is now being given to the establishment of an airport at Bermuda and to the possibility of an air service between Bermuda and New York as a preliminary to a Trans-Atlantic service.

Col. Shelmerdine expressed a belief that the Imperial Airways policy of providing economical, quiet and comfortable machines was the right one, particularly as high speed was a very costly matter. In conclusion, the position of the Light Aeroplane Clubs was explained clearly, starting from the first subsidy scheme in July, 1925; and the growth of taxi and charter work as well as that of joyriding was referred to.

DUBLIN—BERLIN—DUBLIN

LAST week-end the first experimental air mail and passenger service between the Irish Free State and the Continent was successfully carried out by a three-engined Fokker monoplane, PH-AID, piloted by Mr. J. B. Scholte. The flight was organised by Col. Charles F. Russell, who was one of the fourteen passengers on the trip, and the cost of chartering the machine was subscribed by a number of business organisations and private individuals in Dublin and throughout the Free State. Considerable interest was aroused by a wide publicity campaign in the Irish newspapers, and one of the largest crowds that has ever been seen at Baldonnel aerodrome, County Dublin, made the trek out from the city to see the machine.

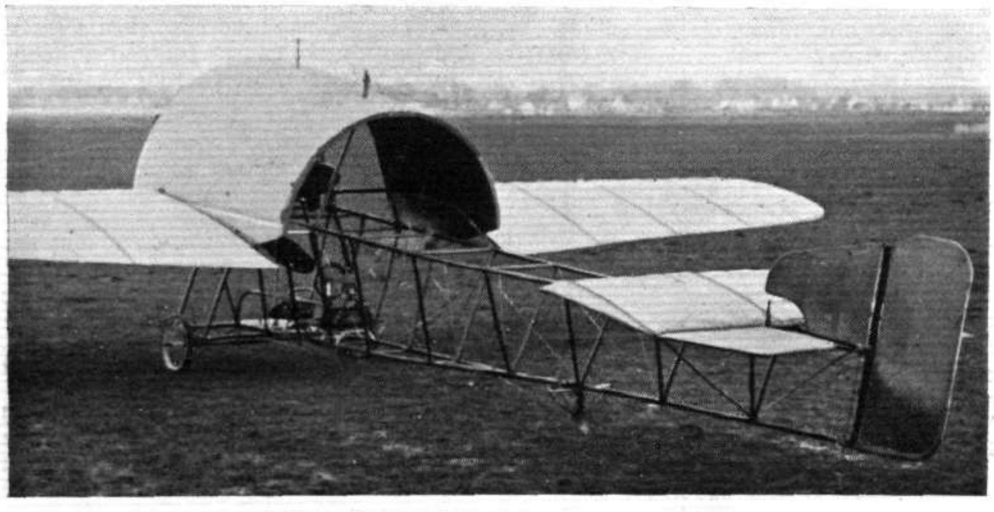
On Saturday morning, October 22, Mr. O. E. Armstrong, piloting the "Fox Moth" of Iona National Airways, left Galway with mails landed at the port from a trans-Atlantic liner and handed them over to officials of Royal Dutch Air Lines at Baldonnel. The Fokker took off at 8 a.m., and, after landings at Croydon (10.20 a.m.) and

Rotterdam (1.05 p.m.), arrived at Templehof aerodrome, Berlin, at 4.30 p.m. (G.M.T.). The return flight was made on the following day, and the mails from Germany for Galway were handed to Mr. Armstrong at Baldonnel, who flew them direct to the disused aerodrome at Oranmore, six miles from Galway.

The flight to Berlin was made in somewhat "sticky" weather, and this had the effect of impressing on the Irish public the efficiency of air services, which they have hitherto had little chance of observing. The Government of the Free State has already expressed its interest in the development of civil aviation, although it has declined to grant a subsidy to the Irish Aero Club, and it is understood that some financial aid will now be requested for the establishment of a service to London to connect with the Continental routes from Croydon. The Fokker monoplane left Baldonnel for London on October 24 with a further load of passengers.

Imperial Airways Feeder Lines

In addition to the development work which is in progress with aerodromes and wireless communication, aerial transport in Africa, and the widespread communities it serves, are now benefiting by schemes which are being pushed ahead vigorously for the establishment of "feeder" air services linking up with the main Imperial Airways Cairo-Capetown route. An excellent example of such "feeder" airlines, extending the benefit of the air mail over areas of hundreds of miles, is the coastal route operated by Wilson Airways, which links up Dar-es-Salaam and other towns in Tanganyika territory with the Imperial Airways route to Nairobi, connections being provided with both the northward and southward Cairo-Capetown services; while another valuable air link is that extending for approximately 200 miles from Kisumu, on the main trans-African line, across the shores of Lake Victoria via Jinja, Torroro, and Eldoret to Entebbe. Further south, along the main route, is another feeder line, the purpose of which is to effect air connections with the Belgian Congo. Operating between Broken Hill and Elizabethville, headquarters of the Katanga province, it is also proposed to extend a further link into the Central Congo at Luluabourg, which, since the institution of the Benguela railway, has been the southern terminus of air services in the Congo. The postal rate from England to Elizabethville, for a half-ounce letter, is 1s. 3d., and for postcards 7d., and the time taken in transit is nine days. Well over 1,000 miles of auxiliary airlines, serving districts far removed from the main route, are represented by these services, and other plans which should prove equally valuable are now actively in hand.



"NOTHING NEW UNDER THE SUN!"

Last week we published illustrations and a short description of a new machine we called "a Flying Venturi Tube," recently constructed by the Italian Caproni firm. As a matter of historical interest we reproduce on this page photos of three machines constructed in France by M. Jourdan during 1911-12, which embody a somewhat similar arrangement. As may be seen, these three machines, which have varying arrangements of the "tubes" (one being semi-tubular), differ from the Caproni mainly in the length of the "tube."

In the first machine shown the pilot is located below the "tube," and the engine (50 h.p. Gnome) is mounted centrally in front of same, with the propeller outside. In the second machine the "tube" has been enlarged, and the engine and propeller placed inside the forward end of the "tube," while the pilot is located at the rear end, where he is efficiently cooled by the slip stream!

AUTOGIRO DEVELOPMENTS

A GREAT deal has been talked about developments of the "Autogiro" recently, and it may perhaps be as well to give a little authentic information in order to clear up many of the inevitable misunderstandings which arise when rumours are allowed to get round. First of all there is that extremely interesting development, the "Autogiro," without a fixed wing projecting from the fuselage. In this model the control column is connected, through the medium of a knuckle joint, to the rotor hub, thus allowing the complete rotor system to be tilted, both fore and aft and laterally, with regard to the fuselage.

An experimental model embodying this principle has been flying at Hanworth for some time, but it is entirely experimental, and in its present form will not be perpetuated. Another interesting addition to this machine is that of a steerable oleo-sprung tail wheel, connected to the rudder bar. This makes taxying on the ground very easy indeed. The advantages of the tilting rotor system are almost innumerable both in the air and on the ground. The degree of control obtained when flying is far more than by any other method, while on the ground it enables the rotor to be tilted forward, thus making the machine safe to taxi into a wind without, as before, having to turn away from the wind to prevent being blown over.

Many interests are already developing the "Autogiro" in several forms. We have already mentioned the small single-seater machine which is being built by Air Com. J. G. Weir at Glasgow, and if the performance figures come up to expectations (there is no reason why they should not do so, as Cierva has so far always been very close to his predictions) it will have a performance very considerably better than any other aircraft of a similar h.p.; the engine being fitted is a 40-h.p. one built by Douglas Motors, Ltd., of Bristol. This little machine, of course, has the tilting rotor system, worked, it is said, by a suspended stick, and, as well, incorporates the steerable tail wheel. The first model is expected to be flying in a few weeks, and we look forward to seeing the amazingly short take-off and steep climb claimed for it.

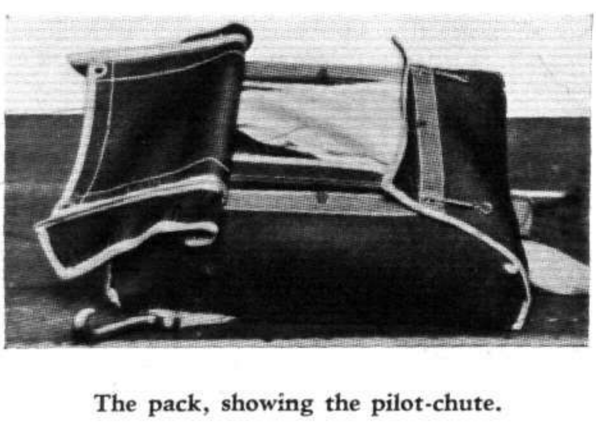
In France developments are going ahead apace, and it is hoped to have the two-seater cabin Pobjoy-engined side-by-side machine, being built there, ready for the Show. This also, of course, incorporates the latest developments, and might well prove to be the much sought after "light car of the air." The growing interest in "Autogiros" can be estimated from the amount of instruction which is being given at the firm's depôt at Hanworth by their chief pilot, Mr. R. A. C. Brie; over 90 hr. being flown during the last month. Incidentally, Mr. Brie is at present hard at work upon the compilation of a book designed for pupils who wish to become proficient in the art of "Autogirating."

Apart from the radical development of the elimination of the fixed wing, another improvement which may have far-reaching effects is the eradication of the vibration period previously experienced at certain speeds and positions. This has been effected by redesigning the blades so that, by the use of a thicker section, the C.P. has now been made to coincide with the C.G. Yet another great advantage of these newer designs is their ability to take-off without altering the ground angle of the fuselage to any appreciable extent. This is, of course, particularly important when larger commercial machines carrying passengers are considered, as also is it for flying-boats, and there are rumours of developments in both these directions.

THE GREGORY-QUILTER PARACHUTE

MR. RAYMOND QUILTER, who as everyone knows, is a very keen private owner and also a parachute demonstrator of no small experience, has recently combined his knowledge with that of Mr. Gregory, who, incidentally, has been associated with parachutes for very many years, and they have now placed upon the market a parachute designed in every detail to the Air Ministry specifications, but at the same time to be sold very cheaply so that it will be possible for every private owner to possess one. It is the boast of Mr. Quilter that they will be able to produce one of their parachutes to fit any make of light aircraft, whatever the design of the seat may be. Particular attention has been paid to matters of vital importance to the private user, such as comfort and service. For the former, the harness, while being of the standard type, is so arranged as to be comfortable. The seat on the pack frame is padded with Sorbo rubber and the pack frame can be made to any shape required. The chief idea is that it should be made possible for parachutes to be sold with light aircraft in the same way as lifebelts are sold with yachts, and with this end in view a small, cheap, but in every way reliable and effective chute has been designed which it is hoped the manufacturers will include in their machine equipment. Innumerable tests have been carried out by Mr. Quilter and on not one of them has a case of failure ever occurred. In general design this parachute follows accepted practice, except that all points which can be made easy for maintenance by private individuals have received special attention. A pilot chute is employed, and this is thrown clear from the pack with extreme rapidity, thus ensuring rapid and certain opening of the main chute. The harness, in keeping with modern practice, incorporates a quick release. Inquiries should be addressed to Gregory Quilter Parachutes, 50, Gresham Street, London, E.C. (Metropolitan 0967).

The G.C. seat-type pack.



The pack, showing the pilot-chute.

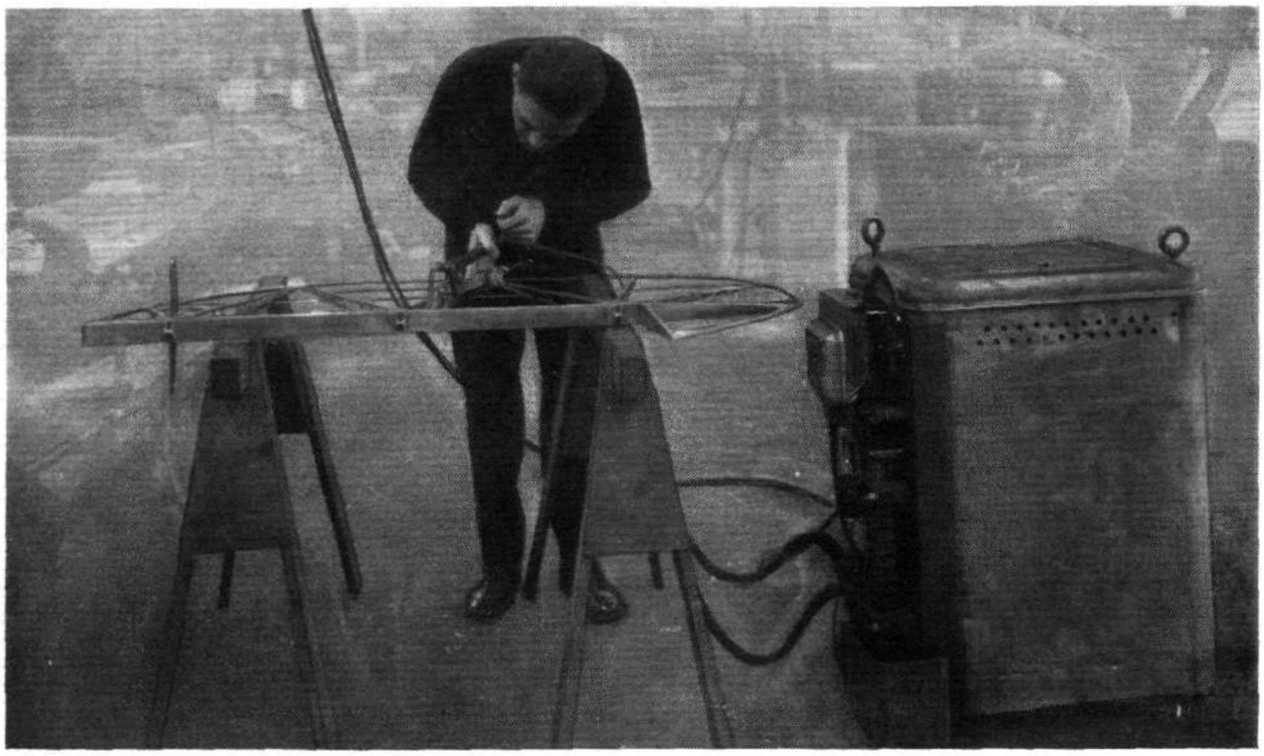


Fig. 1, WELDING TOOL IN USE : The method of connection to the welder is shown, and the general compactness will be noted.

Shot Welding

IN modern aircraft practice, riveting is the predominant method of fabricating metal assemblies—at any rate so far as the British industry is concerned. Most of the steels used to-day are readily weldable, so that the reason for the preference for riveting is less valid than it was some years ago. Probably this is because, hitherto, the designer has felt able to place greater reliance on riveted than on welded structures. Ordinary welding, though it can give joints of great strength when ideal conditions obtain, is more or less a matter of craftsmanship, and there is no ready, non-destructive means of determining whether any individual weld is a good one. On the other hand, riveting is, for all practical purposes, perfectly reliable ; though it is naturally impossible to indicate the exact condition of every rivet in a long run, ordinary testing methods can ensure results in which complete confidence can be placed.

Another objection sometimes urged against welding is that prolonged heating of any kind is often undesirable in fabrication, the more so with alloy steels of the kind used in aircraft construction. Thus, in the interests of safety and caution, present-day practice tends almost entirely to the use of the riveted joint.

Yet welding has much to recommend it. It demands no punching or drilling of plates—processes that, relatively expensive, induce in certain circumstances local weakness ; that being so, a welding process that overcame the existing objections should go far to simplify manufacturing problems.

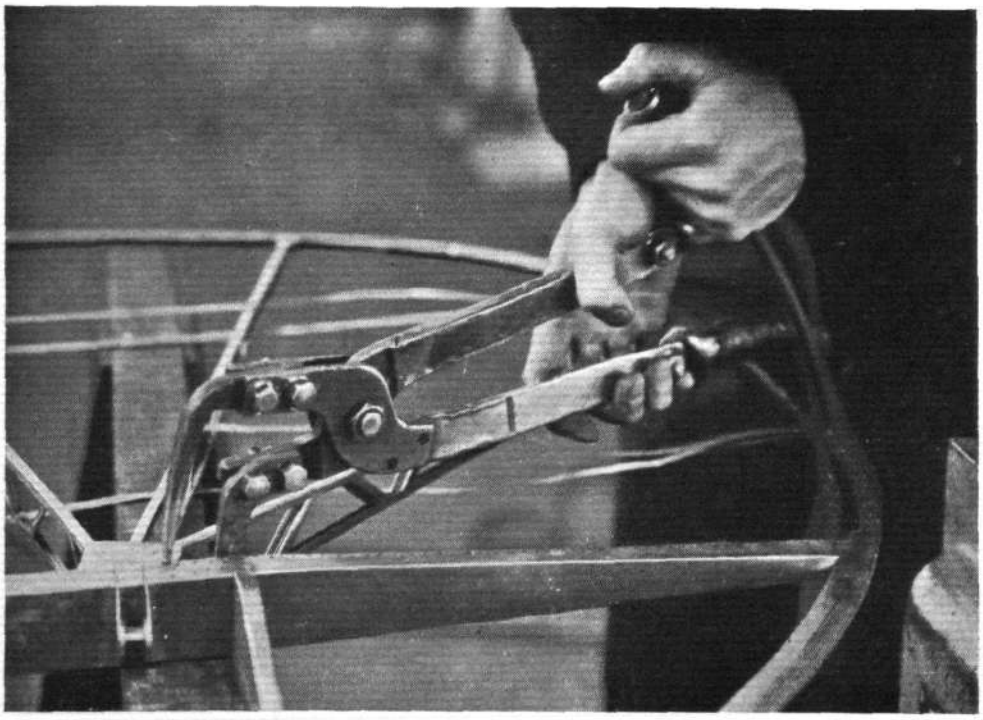


Fig. 2, HAND WELDING TONGS : The appearance of the shot welds can be seen.

The ideal of controlled welding seems to have been realised in the shot-welding process, demonstrations of which have recently been given to the industry in this country by the Pressed Steel Company of Great Britain, Ltd., of Cowley. It introduces many features new to welding technique, and its possible influence on fabrication practice may well be great.

Briefly, shot welding is a form of electric-resistance welding in which the time of current application has been reduced to the shortest possible for causing complete fusion of the metal ; and these short welds are not merely automatically ensured, but are supervised by an automatic weld-recorder that maintains a continuous watch on the conditions of welding.

Good welding is determined by three main factors: proper pressure on the electrodes, proper voltage-current relations, and proper time of current application. In the shot-welding

machines, the two last-named are continuously recorded and checked by means of a device known as a weld-recorder, an outstanding and unique feature of the apparatus. This recorder is the means whereby an automatic record is obtained of the electrical conditions under which each weld was made ; it is, therefore, something that brings welding on an equality with riveting so far as control is concerned.

The recorder is set to conditions determined experimentally by test welds on the material that is subsequently to be used, a number being made and their strength and ductility ascertained. When the required relationship between current and time has been discovered, special current- and time-control switches in the welder are set, and from this point the process becomes automatic and foolproof. As the electrodes grip the metal and the spring pressure on the tongs is overcome, contact is automatically made, the current passes for the set time, and, if good welding conditions obtain, the electrodes are released for the work to be moved along to the next weld.

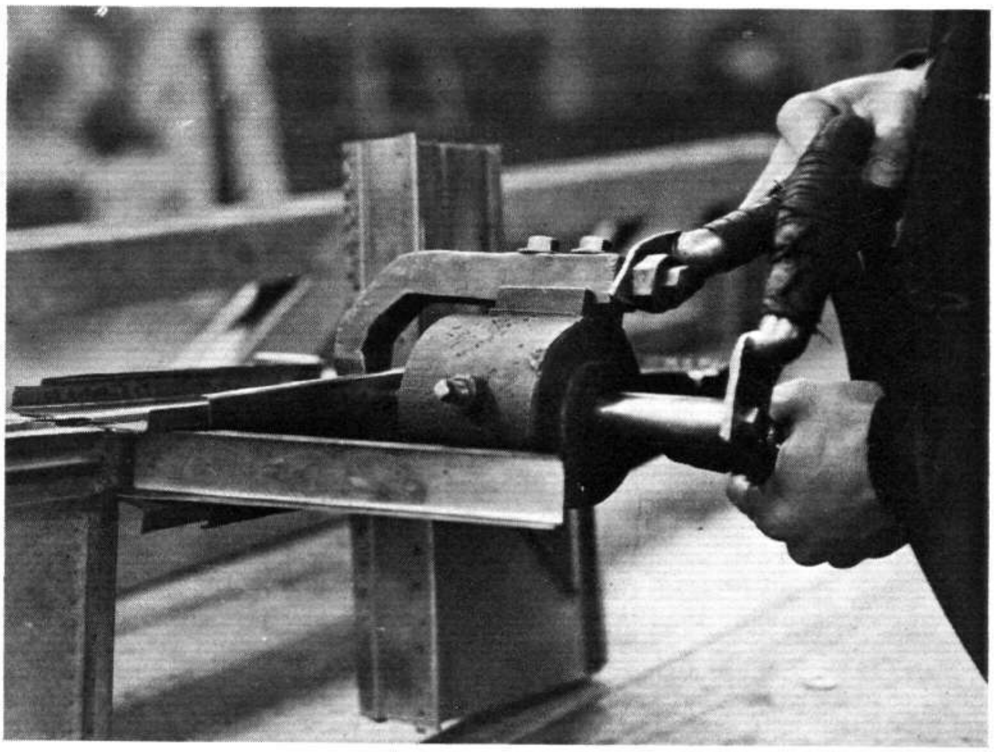


Fig. 3, PNEUMATICALLY CONTROLLED WELDING TOOL : The pressure on the electrodes is automatically determined, and is independent of the skill of the operator.

If, however, for some such reason as faulty electrode contact, bad material, variation of line voltage, or the like, too little or too much current passes—conditions that cause bad or overheated welds—a bell rings, and continues to give warning until the machine is switched off, and good conditions re-established. It may here be noted that the indicator is set to a tolerance so that while the bell operates when faulty welding conditions occur, it works well within the safety range.

In conjunction with this audible control is a permanent graphic record. A continuous strip of paper is fed beneath a stylus, which draws a line for each weld made. The length of this line gives an indication of the time and current conditions relative to each weld, and the strip provides a means whereby conditions can be checked at any desired intervals for purposes of supervision. Thus, the bell acts as an immediate warning to the operator and the shop foreman, while the recorder strip, which is so placed that it cannot be touched by the operator, provides the continuous check modern production control demands.

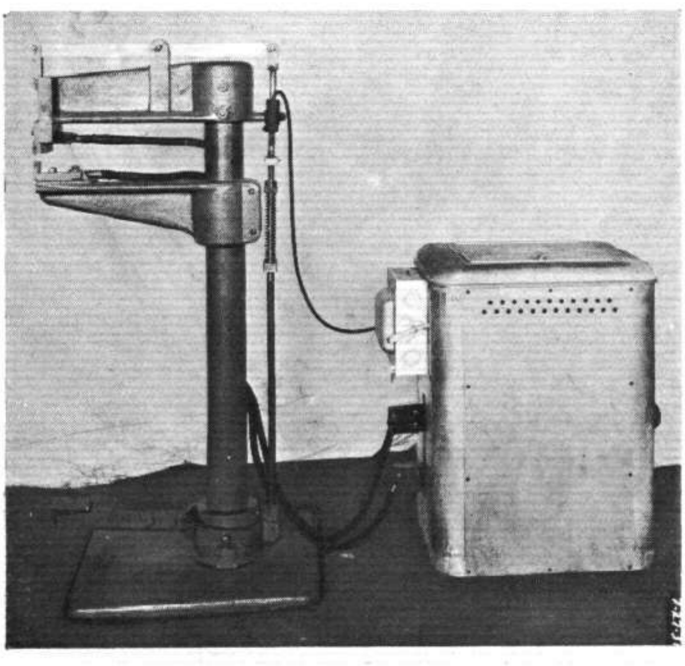


Fig. 4, THE SHOT WELDER : This photograph shows the complete equipment for runs on straight strip or other material that can be fed through a stationary machine.

The general form of the welder and tools will be gathered from the accompanying illustrations. Fig. 4 shows the complete equipment for runs on straight strip or other material that can be fed through a stationary machine. The box on the right is the actual welder ; it contains the transformers, automatic control devices, warning bell, and weld recorder. The cables leading to the electrodes are taken from the lugs seen to the left of the welder, while above them are the main switch and a small cable leading to the recorder contact. The electrodes themselves are of a special hard, high-conductivity material that does not distort under heavy pressure, and are brought together, in the machine shown in Fig. 4, by the action of a pedal provided with a spring-loaded control.

In Figs. 2 and 3 special tools for welding more intricate assemblies are shown. The tongs in Fig. 2 are hand operated, but the special tool shown in Fig. 3 has a pneumatic dashpot in order to ensure the absolute control of electrode pressure that is essential. These tools are connected to the welder in the manner shown in Fig. 1, where the tongs are seen in use on a stainless-steel aileron. It may here be noted that the welder is readily transportable in order that the leads from welder to tool may be kept as short as possible. Figs. 5 and 6 are typical aircraft members built up by shot welding.

Apart from its special merits as an advance in welding technique—which may be briefly summarised as continuous control of work and a very high possible speed of operation—shot welding introduces a solution for one of the biggest problems hitherto existing in this field: the welding of the austenitic stainless steels (" Staybrite," " Anka," etc.). As is well known, these materials have presented many difficulties in fabrication, for, though they appear to be readily weldable, it has been established that heating within the range of 500-900 deg. C. causes an internal change that leads to the loss of their corrosion-resisting properties.

This is due to the fact that within this temperature range the chromium and carbon, which are normally held in solid solution, tend to precipitate out as chromium carbide, which ranges itself along the grain boundaries to render the material liable to the phenomenon known as intergranular corrosion. It will be evident that the short time required in shot welding is a favourable condition.

Shot welding, with its extremely brief heating period, does not, it is claimed, allow sufficient time for this

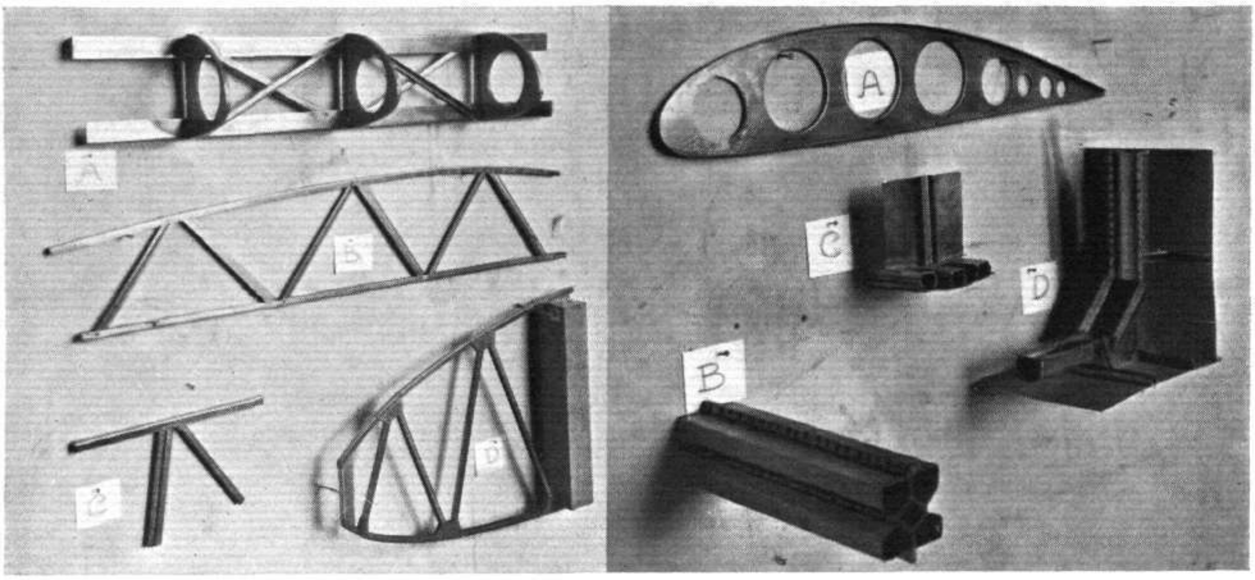


Fig. 5, SPECIMENS OF SHOT-WELDED COMPONENTS : On the left, some lattice members of wing structure. On the right, a wing rib and some shot-welded compression members.

dangerous carbide precipitation to commence ; and considerable success has been gained, more especially in the United States, in the complete assembly of aircraft in austenitic stainless steels by shot welding. An example is a Savoia amphibian built for the Savoia Company of Italy by the Budd Manufacturing Company of Philadelphia.

W. A. R.

THE EAST GREENLAND SURVEY.

DURING the summer of 1932 Norway for the first time used aircraft for their work in East Greenland. The expedition of the year was to the occupied area known as "Erik Raudes Land," and two machines were used, one an American Lockheed "Vega" for aerial mapping, and the other a Hermes II "Spartan" for reconnaissance and general utility work. The pilots were Lt. Storm, in charge of the Lockheed machine, and Lt. Aagenes, in charge of the Hermes II "Spartan."

All the work as originally planned was completed without the slightest mishap. A total flying time of 110 hours was spent in aerial mapping, and the photographer was Herr Max Bunderman, of Berlin. The headquarters of the expedition were located in Mackenzie Bay, close to the Norwegian main radio station. The aerodrome was a fine sandy stretch, 3,000 × 3,500 metres, close to the sea front. Approximately twelve other landing grounds were located around the coast districts, the biggest one being approximately 8,000 metres in one direction. Lt. Aagenes landed the Hermes II "Spartan" on most of these grounds.

The total flying time of this machine and engine was 70 hours during the whole period. Many of the flights were carried out over new land, and a number were over areas where famous explorers, such as Scoresby, Sabine and Clavering were exploring over a hundred years ago.

As suitable landing places were only found along the coast and most of the flights had to be into the interior, the work was very risky, as a forced landing in the mountainous country over which the machines flew would almost invariably have ended in a crash, but the engines in both machines gave fine service without the least trouble. The cases of engine spares were returned unopened at the end of the tour.

Before the Hermes II "Spartan" set out on this trip it had to its credit 600 hours of active service in Norway.

For the trip to Greenland the machines were carried on the deck of a small sealer of approximately 300 tons, the "Vega" on the rear deck and the Hermes II "Spartan" with folded wings on the front deck. The machines were brought ashore on a float made from a couple of large aeroplane floats.

This expedition was a severe test for any aircraft, and has proved that light aircraft such as the Hermes II "Spartan" are able to withstand the severe conditions which were experienced, with every confidence. The Hermes II "Spartan" returned to Norway in as sound condition as when it left. The expedition was away for a total of fifty days, and during this time the machines were kept in active use, as much as six hours being put in in one day by the machines.

Mr. Omsted, the owner of the Hermes II "Spartan," some few days ago, whilst engaged on important newspaper work, carried out a night flight of some six hours' duration in very bad weather. At the end of the flight he spoke highly of his Hermes II engine, which was continuing to give him entire satisfaction.

Landing the Hermes II "Spartan" for operation with the East Greenland Air Survey.

THE ROYAL AIR FORCE

London Gazette, October 18, 1932

General Duties Branch

The follg. are granted permanent commns. as Pilot Officers, with effect from Oct. 10 and with seny. of the dates stated :—R. Faville (Oct. 10, 1931) ; S. F. Godden (Pilot Officer, R.A.F.O.) (Oct. 10, 1931) ; S. E. MacKenzie (Oct. 10, 1931) ; R. G. S. Morgan-Smith (Oct. 10, 1931) ; N. H. J. Tindal (Flying Officer, R.A.F.O.) (Oct. 10, 1931) ; E. G. Villiers (Flying Officer, R.A.F.O.) (Oct. 10, 1931) ; J. G. Bigelow (Feb. 6).

The follg. Acting Pilot Officers on probation are graded as Pilot Officers on probation (Sept. 18) :—R. S. Howe, C. F. M. Rambaut. The follg. Pilot Officers are promoted to rank of Flying Officer :—W. G. A. Coulson (Sept. 13) ; E. A. Douglas-Jones (Sept. 29) ; C. N. Carpenter (Oct. 13).

Flt.-Lt. F. H. D. Henwood, D.F.C., is placed on half-pay list, Scale A (Oct. 4). The follg. Lieuts., R.N., Flying Officers, R.A.F., cease to be attached to R.A.F. on return to Naval duty (Aug. 3) :—J. H. Charsley, W. H. Parkin.

Pilot Officer on probation M. W. Kimpton is transferred to Reserve, Class A (Sept. 19) ; Sub-Lt. A. A. Fitz-R. Talbot, R.N., F/O., R.A.F., relinquishes his temp. commn. on return to Naval duty (Sept. 24).

Accountant Branch

Sqdn. Ldr. G. N. Simon is placed on half-pay list, Scale A (Sept. 25).

Dental Branch

The follg. Flying Officers are promoted to rank of Flt. Lt. :—S. C. Allen, L.D.S. (Oct. 13) ; F. F. Kennedy, L.D.S. (Oct. 15). Flt. Lt. C. F. Pitt, L.D.S., relinquishes his temp. commn. on completion of duty (Oct. 1).

Erratum

In *Gazette* of Oct. 4 (Flight, Oct. 13, 1932, p. 973).—For Sub-Lt. W. P. Lucy, R.N., *read* Lt. W. P. Lucy, R.N.

ROYAL AIR FORCE RESERVE

RESERVE OF AIR FORCE OFFICERS

General Duties Branch

C. F. Almond is granted a commn. in Class AA (i) as Pilot Officer on probation (Oct. 3) ; P/O. on probation F. U. Hollins is confirmed in rank (Sept. 15) ; F/O. E. A. Clear, M.C., is transferred from Class A to Class C (July 31) ; P/O. D. Beevers is transferred from Class AA (ii) to Class C (Sept. 13). The following relinquish their commns. on appointment to permanent commns. in R.A.F. :—F/O. J. L. H. Fletcher, F/O. J. M. D. Ker (Sept. 19) ; F/O. E. G. Villiers, F/O. N. J. Tindal, P/O. S. F. Godden (Oct. 10).

Flt. Lt. L. F. P. Bawn relinquishes his commn. on completion of service and is permitted to retain his rank (Sept. 16) ; F/O. C. U. G. Tristram relinquishes his commn. on completion of service (Oct. 9). *Gazette* June 7 concerning F/O. E. F. Rhodes is cancelled.

Stores Branch

F/O. C. P. Marshall is transferred from Class C to Class B (Oct. 18).

SPECIAL RESERVE

General Duties Branch

The follg. Pilot Officers on probation are confirmed in rank :—G. B. Iles, W. B. Wilson (Aug. 14) ; R. W. Harker (Aug. 18) ; H. S. Laws (Sept. 5).

AUXILIARY AIR FORCE

General Duties Branch

No. 601 (County of London) (Bomber) Squadron.—Pilot Officer R. J. Holland is promoted to rank of Flying Officer (Oct. 3).

No. 608 (North Riding) (Bomber) Squadron.—Pilot Officer K. Pyman is promoted to rank of Flying Officer (Sept. 27).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified :—

General Duties Branch

Wing Commander G. B. Dacre, D.S.O., to Station H.Q., Biggin Hill, 1.10.32, to Command.

Flight Lieutenant A. C. B. Harrison, M.C., to Station H.Q., Biggin Hill, 1.10.32.

Flying Officers : G. Wood to No. 12 (B) Sqdn., Andover, 11.10.32. H. V. Horner to No. 5 (A.C.) Sqdn., Quetta, 11.10.32. R. Brown, to No. 1 (F) Sqdn., Tangmere, 18.10.32. R. G. Whitehead, to No. 32 (F) Sqdn., Biggin Hill, 4.10.32.

Pilot Officers : R. V. Bucknall, to No. 20 (A.C.) Sqdn., Peshawar, 11.10.32. C. N. Carpenter, to No. 20 (A.C.) Sqdn., Peshawar, 11.10.32. W. G. A. Coulson, to No. 60 (B) Sqdn., Kohat, 11.10.32. R. H. Maw, to No. 39 (B) Sqdn., Risalpur, 11.10.32. A. D. Messenger, to No. 202 (F.B.) Sqdn., Malta, 12.10.32. D. G. Keddie, to No. 100 (B) Sqdn., Donibristle, 13.10,32.

Acting Pilot Officers : The undermentioned Acting Pilot Officers are posted to No. 3 Flying Training School, Grantham, 8.10.32, for flying training :—G. N. Amison, J. W. Buchanan, J. O. Carter, G. J. I. Clennell, H. W. Dean, F. H. Dixon, W. G. E. Elborough, J. C. Evans, P. S. Foss, G. R. Howle, G. O. Llewellyn, T. B. Morton, T. C. Sanders, J. H. G. Sarll, E. T. Smith, D. E. Turner, D. F. Walker, and P. N. J. Wilkins.

Stores Branch

Flight Lieutenants : S. R. L. Poole, to R.A.F. Storage Section, Kenley, 1.10.32. B. W. Hemsley, M.B.E., to Station H.Q., Biggin Hill, 1.10.32.

Accountant Branch

Squadron Leader C. H. Moore, to Central Flying School, Wittering, 6.10.32, for Accountant duties vice F./Lt. B. G. Drake.

Flight Lieutenant H. A. Murton to Station H.Q., Biggin Hill, 1.10.32.

Medical Branch

Squadron Leaders : J. Kyle, to H.Q., R.A.F. Middle East, Cairo, 2.10.32, for duty as Deputy Principal Med. Officer. E. N. H. Gray, to No. 4 Flying Training School, Abu Sueir, 17.9.32., for duty as Med. Officer. C. A. Lindup, to Palestine General Hospital, Sarafand, 26.9.32, for duty as Med. Officer.

Flight Lieutenant C. G. Harold, to Station H.Q., Duxford, 18.10.32.

Dental Branch

Flying Officers : J. G. Stewart to No. 2 Flying Training School, Digby, 31.10.32. V. H. Weeks, to H.Q., R.A.F. Cranwell, 25.10.32.

NAVAL APPOINTMENT

The following appointment has been made by the Admiralty :—

Lieutenant P. L. Jamison (F./O., R.A.F.), to *Hermes*, for 403 Flight (Sept. 23).

Royal Air Force : Re-equipment of Units

The following re-equipment of units has recently taken place :—No. 6 (B) Squadron—" Gordon " from Bristol " Fighter " ; No. 14 (B) Squadron—" Gordon " from IIIF G.P. ; No. 35 (B) Squadron—" Gordon " from IIIF G.P. ; No. 207 (B) Squadron—" Gordon " from IIIF G.P. ; No. 13 (A.C.) Squadron—" Audax " from " Atlas " A/C. ; No. 29 (F) Squadron—" Bulldog " from " Siskin " IIIA.

The undermentioned units will be re-equipped as shown during the next few months :—No. 10 (B) Squadron—" Virginia " from " Hinaidi " ; No. 56 (F) Squadron—" Bulldog " from " Siskin " IIIA ; No. 100 (B) Squadron —" Vildebeeste " from " Horsley " T.B. ; R.A.F. College, Cranwell—" Tutor " from Avro 504N ; No. 402 Flight—" Nimrod " from " Flycatcher " ; No. 404 Flight—" Nimrod " and " Osprey " from " Flycatcher " ; No. 407 Flight—" Osprey " from " Flycatcher " ; No. 409 Flight—This Flight will be equipped with " Nimrod " and " Osprey."

R.Ae.S. Awards

The following awards have been made by the Royal Aeronautical Society :—Taylor Gold Medal to Dr. G. V. Lachmann, A.F.R.Ae.S., for his paper on " Control beyond the Stall " ; Busk Memorial Prize to Mr. H. Constant, A.F.R.Ae.S., for his paper on " Aircraft Vibration."

" Aeroplane Covers and Wheels "

On Thursday, October 27, there will be a joint lecture of the Royal Aeronautical Society and the Institution of the Rubber Industry on " Aeroplane Covers and Wheels " by Mr. F. Fellowes, F.I.R.I. The lecture, which will be illustrated, will be delivered at 6.30 p.m. in the Lecture Hall of the Royal Society of Arts, 18, John Street, Adelphi, W.C.2. Mr. Fellowes will deal with modern types of equipment and show their comparative values. The subject is covered in close detail, construction, weight aerodynamic properties, strengths, brakes, design characteristics, etc.

" Civil Primary Training "

On Thursday, November 3, 1932, Mr. H. G. Travers, D.S.C., Chief Instructor of the London Aeroplane Club, will lecture on Civil Primary Training. Mr. Travers discusses in detail the present-day training of civilian pilots, as distinct from the training of military pilots at the C.F.S. He deals with the present regulations for A and B licences, and suggests how they should be modified ; the type of aircraft required (the pusher is strongly advocated). ; and the costs of training. Some of the views put forward will prove very provocative. The lecture will be one of the most stimulating lectures on the practical side of aviation which has been read before the Society for a long time. It will be illustrated by a large number of slides. The lecture will be at the Royal Society of Arts, 18, John Street, Adelphi, London, W.C.2, at 6.30 p.m.

Postponed Lecture

The lecture by Sqd. Ldr. H. Leedham before the R.Ae.S., on " The Evolution of Aircraft Wireless Equipment," announced for November 24, has been postponed until a later date.

AIRCRAFT COMPANIES' STOCKS AND SHARES

UNDER the lead of the further rise in British Government stocks, the stock and share markets as a whole attracted more attention this month, and although at the time of writing they have developed an uncertain tendency industrial shares have been more active. Earlier in the month shares of aircraft and allied companies moved against holders on disappointment with the Imperial Airways dividend, and the absence of half-yearly dividends on Handley-Page preference and Napier **8** per cent. preference. There has since been a good recovery, and Imperial Airways are unchanged on balance at 23s. 6d., as are Handley-Page preference at 9s. 4½d. The market was favourably impressed by the excellent increase in the traffic receipts of Imperial Airways in the current financial year, to which attention is drawn in the report, and by the statements at the annual meeting. Postponement of a dividend until the accounts for the year are made up has not affected Napier **8** per cent. preference, which are unchanged at 12s. 6d. The company's 7½ per cent. preference show an improvement on the month of 1s. 3d. to 20s. in sympathy with the general upward movement in fixed interest-bearing issues, which has been a feature of the month. The ordinary are 3s. 9d., compared with 4s. 3d. Fairey Aviation, which are beginning to come under dividend hopes, are virtually unchanged on the month at 17s., and the debentures gained two points to 111. De Havilland came in for rather more attention, also on the possibility that the dividend may be maintained; there has been a rise on the month from 15s. 6d. to 17s. 3d. In other directions, Rolls-Royce experienced steady support and are 45s., or 3s. higher than a month ago. A point of interest was a sharp rise in Armstrong-Siddeley Development preference from 13s. 9d. to 18s. 9d. in sympathy with the upward movement in fixed interest-bearing issues. Ford Motors reflected the reaction in Wall Street markets with a decline on balance from 25s. 6d. to 23s. 3d. Joseph Lucas had a good rise from 69s. to 78s. 1½d. on the excellent increase in profits and the maintenance of the dividend and bonus at **20** per cent. S. Smith (M.A.) issues have improved, particularly the preferred ordinary (from 14s. 4½d. to 18s. 9d.) on the hope that the dividend on these shares will be forthcoming in full. It may be recalled that earlier in the year their interim dividend was postponed until the end of the company's financial year, although the directors pointed out when making the announcement that earnings warranted the payment. Brown Brothers and British Aluminium both moved sharply in favour of holders. At the time of writing "Shell" are dull under the influence of the decision not to pay an interim dividend. This did not come as a surprise to the market, as a similar course was followed last year.

Name	Class	Nominal Amount of Share	Last Annual Dividend %	Current Week's Quotation
Anglo-American Oil	Deb.	Stk.	5½	102
Armstrong-Siddeley Develop.	Cum. Pref.	£1	6½	18/9
Birmingham Aluminium Castg.	Ord.	£1	5	17/6
Booth (James), 1915	Ord.	£1	15	48/6
Do. do.	Cum. Pref.	£1	7	26/3
British Aluminium	Ord	£1	5	27/3
Do. do.	Cum. Pref.	£1	6	21/3
British Celanese	Ord.	10/-	Nil	8/7½
British Oxygen	Ord.	£1	3	22/9
Do. do.	Cum. Pref.	£1	6½	25/7½
British Piston Ring	Ord.	£1	12½	27/-
British Thomson-Houston ..	Cum. Pref.	£1	7	26/10½
Brown Brothers	Ord.	£1	10	30/-
Do. do.	Cum. Pref.	£1	7½	26/3
Dick (W. B.)	Cum. Pref.	£10	5	125/-
De. Havilland Aircraft ..	Ord.	£1	5	17/3
Dunlop Rubber	Ord.	C	Nil	17/10½
Do. do.	"C" Cum. Pref.	16/-	10	20/-
En-Tout-Cas (Syston)	Def. Ord.	1/-	Nil	-/9
Do. do.	Ptg. Pfd. Ord.	5/-	8	2/6
Fairey Aviation	Ord.	10/-	10*	17/-
Do. do.	1st Mt. Deb.	Stk.	8	111
Firth (T.) & John Brown ..	Cum. Pref.	£1	6D	4/6
Do. do.	Cum. Pref.	£1	5*D	3/6
Ford Motor (England) ..	Ord.	£1	Nil.	23/3
Fox (Samuel)	Mt. Ptual. Deb.	Stk.	5	82½
Goodyear Tyre and Rubber ..	Deb.	Stk.	6½	106
Handley Page	Ptg. Pref.	8/-	10B	9/4½
Hoffmann Manufacturing ..	Ord.	£1	Nil	15/-
Do. do. ..	Cum. Pref.	£1	7½	18/9
Imperial Airways	Ord.	£1	3	23/6
Kayser, Ellison	Ord.	£5	Nil	55/-
Do. do.	Cum. Pref.	£5	6	72/6
Lucas (Joseph)	Ord.	£1	20	78/1½
Napier (D.), & Son	Ord.	5/-	Nil	3/9
Do. do.	Cum. Pref.	£1	7½	20/-
Do. do.	Pref.	£1	8A	12/6
National Flying Services ..	Ord.	2/-	Nil	-/4½
Petters	Ord.	£1	Nil	15/-
Do.	Cum. Pref.	£1	7½	13/9
Roe (A. V.), (Cont. by Armstrong-Siddeley Devel., *q.v.*)	Ord.	£1	—	—
Rolls-Royce	Ord.	£1	10	45/-
Smith (S.) & Sons (M.A.) ..	Def. Ord.	1/-	Nil	-/9
Do. do.	Pt. Ptd. Ord.	£1	7	18/9
Do. do.	Cum. Pref.	£1	7½	18/9
Serck Radiators	Ord.	£1	12½	32/6
"Shell Transport & Trading"	Ord.	£1	7½*	45/7½
Do. do.	Cum. Pref.	£10	5	£11¾
Triplex Safety Glass	Ord.	£1	10	40/-
Vickers	Ord.	6/8	5	7/-
Do.	Cum. Pref.	£1	5*	19/4½
Vickers Aviation (Cont. by Vickers, *q.v.*)	—	—	—	—
Westland Aircraft (Branch of Petters, *q.v.*)	—	—	—	—

* Dividend paid tax free. C £1 unit of stock. D Last xd. March, 1931. A Last xd. September, 1931. B Last xd. July, 1932.

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Aircraft Engineering Training

WE have unfortunately this week had to hold over the continuance of our series of articles on aircraft engineering training, but hope to find space for a further instalment in our next issue. It should then be possible to include information concerning the Technical Colleges and also the many Correspondence Schools which cater for the needs of ground engineers.

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PUBLICATIONS RECEIVED

Facing Fuel Facts. National Benzole Co., Ltd., Wellington House, Buckingham Gate, London, S.W.1

Jupiter VIII F., VIII F.P., XI F. and XI F.P. Aero Engines. Air Publication 1417. Vol. I. London, W.C.: H.M. Stationery Office. Price 5*s*. net.

The Bulldog IIA Aeroplane Jupiter VII F. or VII F.P. Engine. Air Publication 1393. Vol. I. London: H.M. Stationery Office, W.C.2. Price 3*s*. net.

Great Exploits in the Air. By F. V. Monk and H. T. Winter. London and Glasgow: Blackie and Son, Ltd. Price 3*s*. 6*d*. net.

U.S. National Advisory Committee for Aeronautics Reports: No. 415. *Tests of Nacelle-Propeller Combinations in Various Positions with Reference to Wings: Part I.* By D. H. Wood. Price 10 cents. No. 416. *N.A.C.A. Variable-Density Wind Tunnel.* By E. N. Jacobs and I. H. Abbott. Price 5 cents. No. 419. *Wind-Tunnel Research Comparing Lateral Control Devices, Particularly at High Angles of Attack: I—Ordinary Ailerons on Rectangular Wings.* By F. E. Weick and C. J. Wenzinger. No. 420. *Aircraft Speed Instruments.* By K. H. Beij. No. 421. *Measurement of the Differential and Total Thrust and Torque of Six Full-Scale Adjustable-Pitch Propellers.* By G. W. Stickel. Price 10 cents. No. 422. *Wind-Tunnel Research Comparing Lateral Control Devices, Particularly at High Angles of Attack: II—Slotted Ailerons and Frise Ailerons.* By F. E. Weick and R. W. Noyes. No. 423. *Wind-Tunnel Research Comparing Lateral Control Devices, Particularly at High Angles of Attack: III—Ordinary Ailerons Rigged up 10° when Neutral.* By F. E. Weick and C. J. Wenzinger. No. 424. *Wind-Tunnel Research Comparing Lateral Control Devices, Particularly at High Angles of Attack: IV—Floating Tip Ailerons on Rectangular Wings.* By F. E. Weick and T. A. Harris. Price 10 cents. No. 425. *Effect of Nozzle Design and Operating Conditions on the Atomisation and Distribution of Fuel Sprays.* By D. W. Lee. No. 426. *Effect of Humidity on Engine Power at Altitude.* By D. B. Brooks and E. A. Garlock. No. 427. *Effect of Multiple Fixed Slots and a Trailing-Edge on the Lift and Drag of a Clark "Y" Airfoil.* By F. E. Weick and J. A. Shortal.

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NEW COMPANY REGISTERED

GEORGE PAPPIN & SONS. LTD.—Registered in Dublin. Capital: £3,000 in £1 shares. Taking over the business of Geo. Pappin & Sons, carried on by Mrs. Kathleen Pappin at Stephen Street, Dublin, makers and repairers of motor cars and aeroplane radiators, etc. Directors: Mrs. Kathleen Pappin, 48, Templemore Avenue, Rathgar, Dublin; F. Hogg, 14, Tudor Road, Rathmines, Dublin, engineer.

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AERONAUTICAL PATENT SPECIFICATIONS

Abbreviations: Cyl. = cylinder; i.c. = internal combustion; m. = motors.

(The numbers in brackets are those under which the Specification will be printed and abridged, etc.)

APPLIED FOR IN 1931

Published October 20, 1932

17,583. FAIRCHILD AERIAL CAMERA CORPORATION. View-finders for use in aerial photography. (380,809.)

17,792. SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT, LTD., H. N. WYLIE, and P. G. CRABBE. Aerial screw propellers. (380,812.)

26,295. SIEMENS & HALSKE AKT.-GES. Water-cooled i.c. engines with radial cyls. (380,935.)

35,900. J. TOTH. Screw propellers. (381,034.)

Published October 27, 1932

18,402. L. W. WILLIAMS. Electric relay systems for aircraft. (381,202.)

19,466. M. LEUPOLD. Aircraft. (381,243.)

21,70 . COMPER AIRCRAFT CO., LTD., N. COMPER, and M. H. SPENCER. Wings of aeroplanes. (381,270.)

26,033. BENDIX PERROT BRAKES, LTD., and P. E. HALL. Brakes for aircraft. (381,317.)

APPLIED FOR IN 1932

Published October 20, 1932

1,478. H. JUNKERS. Oscillation-damping devices for propeller-driving mechanisms. (381,050.)

13,333. J. MÖLL, JUN., and J. MÖLL. Parachute. (381,124.)